REPORT OF COMMITTEE ON MORTALITY FOR DISABLED LIVES

The Committee on Mortality for Disabled Lives has completed its study of this subject and herewith submits its final report. The report is composed of three parts, a brief narrative description of the work of the Committee, the resultant mortality table with derived commutation columns, and an appendix which covers some of the technical aspects of the work and which is of more limited interest. The study of the Committee has been hampered by circumstances arising from the war which are largely responsible for the delay in submitting the final report.

Origin of Committee

In November 1937 the Council of the Casualty Actuarial Society, acting on the suggestion of Professor A. H. Mowbray, authorized President Leon Senior to appoint a Committee of Three to report on the feasibility of compiling a mortality table for lives disabled under workmen's compensation acts. On March 15th, 1938 this Committee reported that it desired to avoid giving any impression that very substantial results might be expected from a compilation of the experience at the time; that the subject, however, was of such importance that a start should be made in order to get the carriers to keep appropriate records; and that it was as feasible then as it would be at any later time under the current statistical status to compile a mortality table for lives disabled under workmen's compensation acts.

The Council accepted the report and authorized the appointment by the President of an enlarged committee of seven members. The new Committee organized with the National Council on Compensation Insurance serving as secretary and prepared a Call for disability data for cases prior to policy year 1936 which the National Council sent out in October 1938.

Source of Data

In response to the Call, which was sent to all private insurance carriers and state funds, individual case reports or tabulator listings of the material requested in the Call were submitted to the National Council, where the data were recorded on punch cards and compiled. The Committee, after studying

the reports and compilations, found the early years represented results of only a few carriers, as most of the others were unable to report fully for this period. There appeared evidence too, that for the early years some of the shorter term cases may have been overlooked, leaving the experience biased.

To obtain a more representative experience the Committee decided to restrict the data generally to policy years 1930-1935, or to accidents occurring in calendar years 1930-1935 as to carriers reporting on an accident year basis. The decision was made reluctantly as it limited the data materially, but it seemed necessary to prevent undue weight being given to experience of a few carriers interested in certain industries. Further study of the data convinced the Committee that the experience for the first year of observation was defective. There was a general tendency to consider all cases resulting in deaths during this period as fatal cases and thus fail to report any among permanent total. To overcome this defect the Committee decided to eliminate the experience for the first year from the observation of each case. A tabulation of the experience with these restrictions showed a total exposure of 8,598 man-years and 285 deaths or terminations of permanent total disability.

Development of Tables

The decision of the Committee to restrict the data to cases of the last five years and to eliminate the first year of experience for each case precluded study of the experience on a select and ultimate basis. Extensive studies of the data by type of injury, by industry, and by state also were unwarranted.

After reviewing and compiling the data, the mortality rate designated q_x' was calculated for each age on the basis of the raw data. The calculated q_x' was joined with the q_x of the U. S. Life Table—1930, White Males, at ages above 73 years using decreasing weights from age 74 to age 94 to smooth the transition. For ages 17-21, the q_x of the U. S. Life Table—1930 was first raised to the level of the q_x' using the relativity of the rates shown by the ages 22-26, as a group. The raised rates of the U. S. Table were then combined, on a weighted basis, with the q_x' for ages 17-21 to obtain the modified rates which were used in the graduation. The resultant q_x' was graduated by the Whittaker-Henderson technique and the graduated q_x' was used to construct the Mortality Table for Lives Disabled by Industrial Accidents. Commutation columns were constructed and annuity values calculated with interest rates of 2½%, 3%, 3½%, 4%, 5%, and 6%.

Based on the exposure underlying the table the mortality of the Table

for Lives Disabled by Industrial Accidents is 144% of the U. S. Life Table—1930, 125% of the American Experience Table, and 32% of Hunter's Disabled Lives Table.

Respectfully submitted,

COMMITTEE ON MORTALITY FOR DISABLED LIVES
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DEFINITION OF SYMBOLS

The symbols used are defined as follows:

l_x^t denotes the number of permanent total disabled lives living at the beginning of age x.

d_x^t denotes the number dying between ages x and $x+1$. The few cases of recovery in the experience have been included with deaths. The meanings of "fatal", "mortality rate", "dying", etc., are to be construed as having cases of recovery included with deaths.

$q_x^t = d_x^t \div l_x^t$

$D_x^t = v^x \cdot l_x^t$

$N_x^t = \Sigma D_x^t$

$\overline{N}_x^t = \frac{1}{2}(N_x^t + N_{x+1}^t)$

$\bar{a}_x^t = \overline{N}_x^t \div D_x^t$

MORTALITY TABLE FOR LIVES DISABLED BY INDUSTRIAL ACCIDENTS
Based on Permanent Total Disability Cases
under Workmen's Compensation Acts

x	l'_x	q'_x	d'_x	x	l'_x	q'_x	d'_x
15	100000	.03226	3226	60	33221	.03675	1221
6	96774	.03115	3015	1	32000	.03758	1203
7	93759	.03014	2826	2	30797	.03832	1180
8	90933	.02923	2658	3	29617	.03907	1157
9	88275	.02843	2510	4	28460	.03997	1138
20	85765	.02773	2378	65	27322	.04117	1125
1	83387	.02715	2264	6	26197	.04284	1122
2	81123	.02667	2164	7	25075	.04511	1131
3	78959	.02627	2074	8	23944	.04811	1152
4	76885	.02589	1991	9	22792	.05192	1183
25	74894	.02548	1908	70	21609	.05658	1223
6	72986	.02497	1822	1	20386	.06206	1265
7	71164	.02433	1731	2	19121	.06824	1305
8	69433	.02358	1637	3	17816	.07501	1336
9	67796	.02274	1542	4	16480	.08223	1355
30	66254	.02185	1448	75	15125	.08979	1358
1	64806	.02095	1358	6	13767	.09758	1343
2	63448	.02007	1273	7	12424	.10556	1311
3	62175	.01924	1196	8	11113	.11368	1263
4	60979	.01843	1127	9	9850	.12199	1202
35	59852	.01781	1066	80	8648	.13052	1129
6	58786	.01727	1015	1	7519	.13935	1048
7	57771	.01686	974	2	6471	.14851	961
8	56797	.01662	944	3	5510	.15808	871
9	55853	.01654	924	4	4639	.16812	780
40	54929	.01665	915	85	3859	.17872	690
1	54014	.01693	914	6	3169	.18995	602
2	53100	.01739	923	7	2567	.20190	518
3	52177	.01800	939	8	2049	.21464	440
4	51238	.01873	960	9	1609	.22829	367
45	50278	.01955	983	90	1242	.24294	302
6	49295	.02045	1008	1	940	.25871	243
7	48287	.02139	1033	2	697	.27573	192
8	47254	.02237	1057	3	505	.29413	149
9	46197	.02341	1081	4	356	.31403	112
50	45116	.02449	1105	95	244	.33557	82
1	44011	.02562	1128	6	162	.35887	58
2	42883	.02682	1150	7	104	.38407	40
3	41733	.02809	1172	8	64	.41127	26
4	40561	.02942	1193	9	38	.44056	17
55	39368	.03079	1212	100	21	.47202	10
6	38156	.03216	1227	1	11	.50571	6
7	36929	.03348	1236	2	5	.54166	3
8	35693	.03470	1239	3	2	.57989	1
9	34454	.03580	1233	4	1	.62042	1

COMMUTATION COLUMNS AND LIFE ANNUITIES — 2½%

Based on Mortality Table for Lives Disabled by Industrial Accidents

x	D_x^t	$\overline{N}_x^t$	$\bar{a}_x^t$	x	D_x^t	$\overline{N}_x^t$	$\bar{a}_x^t$
15	69046.56	1319034.86	19.1036	60	7550.588	85600.417	11.3369
6	65189.38	1251916.89	19.2043	1	7095.683	78277.282	11.0317
7	61617.96	1188513.22	19.2884	2	6662.370	71398.255	10.7166
8	58303.14	1128552.67	19.3566	3	6250.828	64941.656	10.3893
9	55218.46	1071791.87	19.4100	4	5860.133	58886.176	10.0486
20	52339.88	1018012.70	19.4500	65	5488.596	53211.811	9.6950
1	49647.48	967019.02	19.4777	6	5134.243	47900.392	9.3296
2	47121.49	918634.54	19.4950	7	4794.485	42936.028	8.9553
3	44745.84	872700.87	19.5035	8	4466.566	38305.502	8.5761
4	42507.83	829074.04	19.5040	9	4147.971	33998.234	8.1964
25	40397.12	787621.56	19.4970	70	3836.756	30005.870	7.8206
6	38407.77	748219.12	19.4809	1	3531.324	26321.830	7.4538
7	36535.58	710747.44	19.4536	2	3231.411	22940.463	7.0992
8	34777.45	675090.93	19.4117	3	2937.433	19856.041	6.7597
9	33129.28	641137.56	19.3526	4	2650.887	17061.881	6.4363
30	31586.11	608779.87	19.2737	75	2373.589	14549.643	6.1298
1	30142.23	577915.70	19.1730	6	2107.781	12308.958	5.8398
2	28790.84	548449.16	19.0494	7	1855.769	10327.183	5.5649
3	27525.06	520291.21	18.9025	8	1619.459	8589.569	5.3040
4	26337.15	493360.11	18.7325	9	1400.396	7079.641	5.0555
35	25219.90	467581.58	18.5402	80	1199.517	5779.685	4.8183
6	24166.55	442888.36	18.3265	1	1017.482	4671.185	4.5909
7	23170.04	419220.06	18.0932	2	854.3079	3735.2899	4.3723
8	22223.81	396523.14	17.8423	3	709.6935	2953.2892	4.1614
9	21321.40	374750.53	17.5763	4	582.9344	2306.9752	3.9575
40	20457.24	353861.21	17.2976	85	473.0926	1778.9617	3.7603
1	19625.82	333819.68	17.0092	6	379.0267	1352.9021	3.5694
2	18823.14	314595.20	16.7132	7	299.5363	1013.6206	3.3840
3	18044.84	296161.21	16.4125	8	233.2608	747.2220	3.2034
4	17287.90	278494.84	16.1092	9	178.7031	541.2401	3.0287
45	16550.23	261575.78	15.8050	90	134.5779	384.5996	2.8578
6	15830.88	245385.22	15.5004	1	99.3702	267.6255	2.6932
7	15128.94	229905.31	15.1964	2	71.8848	181.9980	2.5318
8	14444.19	215118.75	14.8931	3	50.8126	120.6493	2.3744
9	13776.68	201008.31	14.5905	4	34.9467	77.7697	2.2254
50	13126.15	187556.90	14.2888	95	23.3681	48.6123	2.0803
1	12492.35	174747.65	13.9884	6	15.1365	29.3599	1.9397
2	11875.29	162563.83	13.6893	7	9.48022	17.05157	1.7986
3	11274.95	150988.71	13.3915	8	5.69169	9.46562	1.6631
4	10691.04	140005.71	13.0956	9	3.29702	4.97126	1.5078
55	10123.50	129598.44	12.8017	100	1.77760	2.43395	1.3692
6	9572.524	119750.424	12.5098	1	.908411	1.09094	1.2009
7	9038.727	110444.799	12.2191	2	.402843	.435315	1.0806
8	8523.124	101663.873	11.9280	3	.157207	.155290	.9878
9	8026.600	93389.011	11.6349	4	.076686	.033343	.5000

COMMUTATION COLUMNS AND LIFE ANNUITIES — 3%

Based on Mortality Table for Lives Disabled by Industrial Accidents

x	D_x^i	$\overline{N}_x^i$	$\bar{a}_x^i$	x	D_x^i	$\overline{N}_x^i$	$\bar{a}_x^i$
15	64186.19	1128606.15	17.5833	60	5638.703	61373.125	10.8843
6	60306.35	1066359.88	17.6824	1	5273.261	55917.143	10.6039
7	56725.73	1007843.84	17.7670	2	4927.203	50816.911	10.3135
8	53413.55	952774.20	17.8377	3	4600.403	46053.108	10.0107
9	50342.00	900896.42	17.8955	4	4291.930	41606.941	9.6942
20	47486.00	851982.42	17.9418	65	4000.304	37460.824	9.3645
1	44824.62	805827.11	17.9773	6	3723.872	33598.736	9.0225
2	42337.49	762246.06	18.0040	7	3460.563	30006.519	8.6710
3	40007.87	721073.38	18.0233	8	3208.230	26672.122	8.3137
4	37822.32	682158.28	18.0359	9	2964.927	23585.544	7.9548
25	35769.79	645362.23	18.0421	70	2729.161	20738.500	7.5989
6	33843.22	610555.72	18.0407	1	2499.707	18124.066	7.2505
7	32037.26	577615.48	18.0295	2	2276.305	15736.060	6.9130
8	30347.55	546423.08	18.0055	3	2059.173	13568.321	6.5892
9	28768.99	516864.81	17.9660	4	1849.280	11614.094	6.2803
30	27295.77	488832.43	17.9087	75	1647.796	9865.556	5.9871
1	25921.56	462223.76	17.8316	6	1456.165	8313.576	5.7092
2	24639.21	436943.38	17.7337	7	1275.837	6947.575	5.4455
3	23441.60	412902.97	17.6141	8	1107.969	5755.672	5.1948
4	22321.05	390021.65	17.4733	9	953.445	4724.965	4.9557
35	21270.41	368225.92	17.3117	80	812.714	3841.885	4.7272
6	20283.07	347449.18	17.1300	1	686.033	3092.512	4.5078
7	19352.30	327631.49	16.9298	2	573.217	2462.887	4.2966
8	18471.87	308719.41	16.7129	3	473.873	1939.342	4.0925
9	17635.78	290665.58	16.4816	4	387.344	1508.733	3.8951
40	16838.86	273428.26	16.2379	85	312.832	1158.645	3.7037
1	16076.08	256970.79	15.9847	6	249.414	877.522	3.5183
2	15343.73	241260.89	15.7237	7	196.150	654.740	3.3380
3	14637.89	226270.08	15.4578	8	152.008	480.661	3.1621
4	13955.79	211973.24	15.1889	9	115.889	346.713	2.9918
45	13295.44	198347.62	14.9185	90	86.8503	245.3429	2.8249
6	12655.83	185371.99	14.6472	1	63.8176	170.0089	2.6640
7	12035.96	173026.09	14.3758	2	45.9418	115.1292	2.5060
8	11435.41	161290.41	14.1045	3	32.3169	75.9999	2.3517
9	10854.00	150145.70	13.8332	4	22.1182	48.7823	2.2055
50	10291.28	139573.06	13.5623	95	14.7182	30.3641	2.0630
1	9746.817	129554.012	13.2919	6	9.48727	18.26138	1.9248
2	9220.394	120070.406	13.0223	7	5.91320	10.56114	1.7860
3	8711.776	111104.321	12.7533	8	3.53290	5.83809	1.6525
4	8220.506	102638.180	12.4856	9	2.03656	3.05336	1.4993
55	7746.331	94654.762	12.2193	100	1.09269	1.48873	1.3624
6	7289.173	87137.010	11.9543	1	.555690	.664540	1.1959
7	6849.292	80067.777	11.6899	2	.245230	.264080	1.0769
8	6427.231	73429.516	11.4248	3	.0952348	.0938479	.9854
9	6023.424	67204.188	11.1571	4	.0462305	.0231153	.5000

COMMUTATION COLUMNS AND LIFE ANNUITIES — 3½%

Based on Mortality Table for Lives Disabled by Industrial Accidents

x	D_x^i	$\overline{N}_x^i$	$\bar{a}_x^i$	x	D_x^i	$\overline{N}_x^i$	$\bar{a}_x^i$
15	59689.06	971083.94	16.2690	60	4216.88	44117.99	10.4622
6	55810.14	913334.34	16.3650	1	3924.54	40047.28	10.2043
7	52242.87	859307.84	16.4483	2	3649.28	36260.37	9.9363
8	48954.79	808709.01	16.5195	3	3390.78	32740.34	9.6557
9	45916.74	761273.24	16.5794	4	3148.13	29470.89	9.3614
20	43102.56	716763.59	16.6293	65	2920.05	26436.80	9.0535
1	40490.30	674967.16	16.6698	6	2705.13	23624.21	8.7331
2	38058.90	635692.56	16.7029	7	2501.71	21020.79	8.4026
3	35790.98	598767.62	16.7296	8	2308.09	18615.89	8.0655
4	33672.33	564035.97	16.7507	9	2122.75	16400.47	7.7260
25	31691.17	531354.22	16.7666	70	1944.51	14366.84	7.3884
6	29839.43	500588.92	16.7761	1	1772.42	12508.37	7.0572
7	28110.65	471613.88	16.7771	2	1606.22	10819.05	6.7357
8	26499.40	444308.85	16.7668	3	1445.99	9292.95	6.4267
9	24999.65	418559.33	16.7426	4	1292.32	7923.79	6.1314
30	23604.87	394257.07	16.7024	75	1145.96	6704.65	5.8507
1	22308.19	371300.54	16.6441	6	1007.80	5627.77	5.5842
2	21102.15	349595.37	16.5668	7	878.728	4684.506	5.3310
3	19979.48	329054.55	16.4696	8	759.424	3865.430	5.0899
4	18932.52	309598.55	16.3527	9	650.352	3160.542	4.8597
35	17954.22	291155.18	16.2165	80	551.681	2559.526	4.6395
6	17038.11	273659.02	16.0616	1	463.438	2051.966	4.4277
7	16177.71	257051.11	15.8892	2	385.356	1627.569	4.2235
8	15367.10	241278.70	15.7010	3	317.032	1276.375	4.0260
9	14600.67	226294.82	15.4989	4	257.890	988.914	3.8346
40	13873.55	212057.71	15.2850	85	207.274	756.332	3.6489
1	13181.11	198530.38	15.0617	6	164.457	570.467	3.4688
2	12519.87	185679.89	14.8308	7	128.711	423.882	3.2933
3	11886.23	173476.84	14.5948	8	99.2638	309.8948	3.1219
4	11277.60	161894.92	14.3554	9	75.3121	222.6069	2.9558
45	10692.08	150910.08	14.1142	90	56.1682	156.8667	2.7928
6	10128.54	140499.77	13.8717	1	41.0729	108.2462	2.6355
7	9585.92	130642.54	13.6286	2	29.4252	72.9971	2.4808
8	9063.62	121317.77	13.3851	3	20.5986	47.9852	2.3295
9	8561.24	112505.34	13.1412	4	14.0300	30.6709	2.1861
50	8078.17	104185.64	12.8972	95	9.29089	19.01044	2.0461
1	7613.83	96339.64	12.6532	6	5.95993	11.38503	1.9103
2	7167.82	88948.81	12.4095	7	3.69674	6.55669	1.7736
3	6739.71	81995.05	12.1660	8	2.19799	3.60933	1.6421
4	6328.92	75460.73	11.9232	9	1.26092	1.87987	1.4909
55	5935.04	69328.75	11.6813	100	.673262	.912781	1.3558
6	5557.80	63582.33	11.4402	1	.340736	.405782	1.1909
7	5197.18	58204.84	11.1993	2	.149643	.160593	1.0732
8	4853.36	53179.57	10.9573	3	.0578328	.0568549	.9831
9	4526.46	48489.66	10.7125	4	.0279385	.0139693	.5000

COMMUTATION COLUMNS AND LIFE ANNUITIES — 4%

Based on Mortality Table for Lives Disabled by Industrial Accidents

x	D_x^i	$\overline{N}_x^i$	$\bar{a}_x^i$	x	D_x^i	$\overline{N}_x^i$	$\bar{a}_x^i$
15	55526.45	839864.02	15.1255	60	3158.00	31795.24	10.0682
6	51668.43	786266.58	15.2175	1	2924.93	28753.78	9.8306
7	48133.36	736365.68	15.2984	2	2706.71	25937.96	9.5828
8	44887.08	689855.46	15.3687	3	2502.89	23333.16	9.3225
9	41899.06	646462.39	15.4290	4	2312.60	20925.41	9.0484
20	39142.02	605941.85	15.4806	65	2134.74	18701.74	8.7607
1	36593.02	568074.33	15.5241	6	1968.12	16650.31	8.4600
2	34230.29	532662.68	15.5612	7	1811.37	14760.57	8.1488
3	32035.74	499529.66	15.5929	8	1663.14	13023.31	7.8306
4	29994.49	468514.55	15.6200	9	1522.24	11430.62	7.5091
25	28094.00	439470.30	15.6429	70	1387.72	9975.64	7.1885
6	26325.26	412260.67	15.6603	1	1258.82	8652.37	6.8734
7	24680.86	386757.61	15.6703	2	1135.30	7455.31	6.5668
8	23154.34	362840.01	15.6705	3	1017.13	6379.10	6.2717
9	21738.88	340393.40	15.6583	4	904.670	5418.196	5.9891
30	20427.35	319310.29	15.6315	75	798.353	4566.685	5.7201
1	19212.41	299490.41	15.5884	6	698.723	3818.147	5.4645
2	18086.35	280841.03	15.5278	7	606.310	3165.630	5.2211
3	17041.81	263276.95	15.4489	8	521.472	2601.739	4.9892
4	16071.14	246720.47	15.3518	9	444.429	2118.789	4.7674
35	15167.42	231101.19	15.2367	80	375.187	1708.981	4.5550
6	14324.31	216355.33	15.1041	1	313.660	1364.557	4.3504
7	13535.56	202425.39	14.9551	2	259.560	1077.947	4.1530
8	12795.53	189259.85	14.7911	3	212.512	841.911	3.9617
9	12098.91	176812.63	14.6139	4	172.038	649.636	3.7761
40	11441.11	165042.62	14.4254	85	137.607	494.814	3.5958
1	10817.81	153913.16	14.2278	6	108.656	371.682	3.4207
2	10225.73	143391.39	14.0226	7	84.6301	275.0390	3.2499
3	9661.52	133447.76	13.8123	8	64.9543	200.2468	3.0829
4	9122.74	124055.63	13.5985	9	49.0444	143.2474	2.9208
45	8607.51	115190.51	13.3826	90	36.4017	100.5244	2.7615
6	8114.64	106829.43	13.1650	1	26.4907	69.0782	2.6076
7	7642.99	98950.62	12.9466	2	18.8871	46.3893	2.4561
8	7191.81	91533.22	12.7274	3	13.1580	30.3667	2.3079
9	6760.52	84557.05	12.5075	4	8.91901	19.32817	2.1671
50	6348.39	78002.60	12.2870	95	5.87791	11.92971	2.0296
1	5954.71	71851.05	12.0663	6	3.75244	7.11453	1.8960
2	5578.94	66084.22	11.8453	7	2.31633	4.08015	1.7615
3	5220.51	60684.50	11.6242	8	1.37060	2.23668	1.6319
4	4878.75	55634.87	11.4035	9	.782496	1.160133	1.4826
55	4553.13	50918.93	11.1833	100	.415800	.560985	1.3492
6	4243.22	46520.75	10.9635	1	.209424	.248373	1.1860
7	3948.82	42424.73	10.7436	2	.0915315	.0978954	1.0695
8	3669.86	38615.39	10.5223	3	.0352044	.0345274	.9808
9	3406.22	35077.35	10.2980	4	.0169252	.0084626	.5000

COMMUTATION COLUMNS AND LIFE ANNUITIES — 5%

Based on Mortality Table for Lives Disabled by Industrial Accidents

x	D_x^t	$\overline{N}_x^t$	$\bar{a}_x^t$	x	D_x^t	$\overline{N}_x^t$	$\bar{a}_x^t$
15	48101.71	636990.69	13.2426	60	1778.50	16637.27	9.3547
6	44333.28	590773.19	13.3257	1	1631.56	14932.24	9.1521
7	40906.74	548153.18	13.4001	2	1495.45	13368.74	8.9396
8	37784.54	508807.54	13.4660	3	1369.67	11936.18	8.7146
9	34933.42	472448.56	13.5243	4	1253.49	10624.60	8.4760
20	32323.93	438819.89	13.5757	65	1146.06	9424.82	8.2237
1	29931.13	407692.36	13.6210	6	1046.54	8328.52	7.9581
2	27731.89	378860.85	13.6616	7	954.021	7328.244	7.6814
3	25706.78	352141.51	13.6984	8	867.608	6417.429	7.3967
4	23839.57	327368.34	13.7321	9	786.541	5590.355	7.1075
25	22116.41	304390.35	13.7631	70	710.206	4841.981	6.8177
6	20526.63	283068.83	13.7903	1	638.104	4167.826	6.5316
7	19061.16	263274.93	13.8121	2	570.008	3563.770	6.2521
8	17711.91	244888.40	13.8262	3	505.814	3025.859	5.9822
9	16470.79	227797.05	13.8304	4	445.604	2550.150	5.7229
30	15329.68	211896.81	13.8227	75	389.491	2132.603	5.4754
1	14280.62	197091.66	13.8013	6	337.638	1769.038	5.2395
2	13315.59	183293.56	13.7653	7	290.192	1455.123	5.0143
3	12427.07	170422.23	13.7138	8	247.210	1186.422	4.7992
4	11607.65	158404.87	13.6466	9	208.680	958.477	4.5930
35	10850.59	147175.75	13.5638	80	174.491	766.892	4.3950
6	10149.84	136675.53	13.4658	1	144.487	607.403	4.2039
7	9499.61	126850.81	13.3533	2	118.426	475.946	4.0189
8	8894.72	117653.64	13.2274	3	96.0371	368.7148	3.8393
9	8330.36	109041.10	13.0896	4	77.0055	282.1935	3.6646
40	7802.43	100974.71	12.9414	85	61.0077	213.1869	3.4944
1	7307.10	93419.94	12.7848	6	47.7137	158.8262	3.3287
2	6841.38	86345.70	12.6211	7	36.8092	116.5647	3.1667
3	6402.35	79723.84	12.4523	8	27.9824	84.1689	3.0079
4	5987.74	73528.79	12.2799	9	20.9271	59.7142	2.8534
45	5595.77	67737.04	12.1050	90	15.3845	41.5584	2.7013
6	5225.11	62326.60	11.9283	1	11.0893	28.3215	2.5539
7	4874.53	57276.78	11.7502	2	7.83100	18.86135	2.4085
8	4543.10	52567.96	11.5709	3	5.40365	12.24403	2.2659
9	4229.98	48181.42	11.3905	4	3.62789	7.72826	2.1302
50	3934.28	44099.29	11.2090	95	2.36814	4.73024	1.9974
1	3655.17	40304.57	11.0267	6	1.49741	2.79747	1.8682
2	3391.89	36781.04	10.8438	7	.91552	1.59100	1.7378
3	3143.74	33513.22	10.6603	8	.53658	.86495	1.6120
4	2909.96	30486.37	10.4766	9	.30342	.44495	1.4664
55	2689.87	27686.46	10.2929	100	.15969	.21339	1.3363
6	2482.92	25100.06	10.1091	1	.079666	.093715	1.1763
7	2288.64	22714.28	9.9248	2	.034488	.036638	1.0623
8	2106.70	20516.61	9.7387	3	.013138	.012825	.9762
9	1936.74	18494.89	9.5495	4	.0062562	.0031281	.5000

COMMUTATION COLUMNS AND LIFE ANNUITIES — 6%

Based on Mortality Table for Lives Disabled by Industrial Accidents

x	D_x^i	$\overline{N}_x^i$	$\bar{a}_x^i$	x	D_x^i	$\overline{N}_x^i$	$\bar{a}_x^i$
15	41726.51	490978.66	11.7666	60	1007.07	8789.14	8.7274
6	38094.73	451068.04	11.8407	1	915.149	7828.034	8.5538
7	34818.75	414611.30	11.9077	2	830.894	6955.012	8.3705
8	31857.81	381273.02	11.9680	3	753.827	6162.652	8.1752
9	29176.04	350756.09	12.0221	4	683.376	5444.050	7.9664
20	26741.93	322797.11	12.0708	65	618.914	4792.905	7.7441
1	24528.74	297161.77	12.1148	6	559.840	4203.528	7.5084
2	22512.05	273641.38	12.1553	7	505.532	3670.842	7.2613
3	20671.25	252049.73	12.1933	8	455.405	3190.374	7.0056
4	18988.94	232219.63	12.2292	9	408.957	2758.193	6.7445
25	17450.20	214000.06	12.2635	70	365.784	2370.822	6.4815
6	16043.05	197253.44	12.2953	1	325.548	2025.156	6.2208
7	14757.14	181853.34	12.3231	2	288.064	1718.350	5.9652
8	13583.18	167683.18	12.3449	3	253.210	1447.713	5.7174
9	12512.21	154635.49	12.3588	4	220.965	1210.626	5.4788
30	11535.49	142611.64	12.3629	75	191.318	1004.484	5.2503
1	10644.70	131521.54	12.3556	6	164.283	826.684	5.0321
2	9831.74	121283.32	12.3359	7	139.866	674.609	4.8233
3	9089.13	111822.89	12.3029	8	118.025	545.664	4.6233
4	8409.71	103073.47	12.2565	9	98.690	437.306	4.4311
35	7787.06	94975.08	12.1965	80	81.743	347.090	4.2461
6	7215.44	87473.83	12.1231	1	67.048	272.694	4.0671
7	6689.49	80521.37	12.0370	2	54.437	211.952	3.8935
8	6204.44	74074.40	11.9389	3	43.728	162.869	3.7246
9	5755.96	68094.20	11.8302	4	34.732	123.639	3.5598
40	5340.32	62546.06	11.7120	85	27.257	92.645	3.3989
1	4954.11	57398.85	11.5861	6	21.116	68.458	3.2420
2	4594.60	52624.49	11.4536	7	16.137	49.832	3.0881
3	4259.19	48197.60	11.3161	8	12.151	35.687	2.9370
4	3945.79	44095.11	11.1752	9	9.0019	25.1108	2.7895
45	3652.70	40295.86	11.0318	90	6.5553	17.3322	2.6440
6	3378.57	36780.23	10.8863	1	4.6805	11.7143	2.5028
7	3122.16	33529.86	10.7393	2	3.2741	7.7370	2.3631
8	2882.42	30527.57	10.5910	3	2.2379	4.9810	2.2257
9	2658.44	27757.14	10.4411	4	1.4883	3.1179	2.0949
50	2449.28	25203.28	10.2901	95	.96236	1.89254	1.9666
1	2254.04	22851.62	10.1381	6	.60277	1.10998	1.8415
2	2071.95	20688.63	9.9851	7	.36506	.62606	1.7150
3	1902.26	18701.52	9.8312	8	.21194	.33756	1.5927
4	1744.18	16878.30	9.6769	9	.11872	.17223	1.4507
55	1597.06	15207.68	9.5223	100	.061891	.081929	1.3238
6	1460.28	13679.01	9.3674	1	.030584	.035691	1.1670
7	1333.32	12282.21	9.2117	2	.013115	.013841	1.0554
8	1215.75	11007.68	9.0542	3	.0049490	.0048090	.9717
9	1107.12	9846.24	8.8936	4	.0023345	.0011673	.5000

APPENDIX

Some of the technical aspects of the investigation will be discussed in the appendix under these headings:

Call for Experience
Compilation and Tabulation of Reports
Graduation of Mortality Rates
Comparison of Mortality Rates

supplemented with these Exhibits:

Exhibit I	Form for reporting experience NC 159
Exhibit II	Illustrative Work Sheet for compiling exposure and fatalities by age at entry and year of disability
Exhibit III	Illustrative work sheet showing exposure and deaths by age at entry and year of disability
Exhibit IV	Table showing exposure, number dying during the year and the mortality rate for each age
Exhibit V	Table showing crude mortality rates adjusted for the high and low ages by averaging them with the U. S. Life Table 1930
Exhibit VI	Table showing the graduation process
Exhibit VII	Graph showing the adjusted crude mortality rates and the graduated rates
Exhibit VIII	Table showing comparison of actual number of deaths and expected number from graduated mortality rates
Exhibit IX	Table showing comparison of the results of the Casualty Actuarial Society table with other mortality tables

Call for Experience

The Committee's Call for experience as issued by the National Council on Compensation Insurance in October 1938 requested these data:

Compensation Cases Requested. Reports of following workmen's compensation cases were requested.

1. Permanent total disability
2. Permanent partial disability on non-dismemberment amounting to 50% or more of permanent total disability
3. Temporary total disability involving a duration of more than 18 months

The Committee in its final compilations restricted the data to permanent total disability and non-dismemberment permanent partial cases.

States Covered by Call. All states having workmen's compensation laws were covered by the Call.

Period for the Call. The Call covered all years up to and including policy year 1935 with the years 1930-1935 as a minimum. In the compilations later the cases were restricted generally to those of the minimum period by the Committee. The Committee also eliminated the experience of the first year of each case as it became evident that the data were biased because of inadequate reporting of cases terminated early.

Insurance Carriers. All insurance carriers, private and state funds, were asked to file reports. The final results included returns from the following:

	Number
Private Carriers	66
State Funds	9
Second Injury Fund	1

Form of the Call. The form used in the Call—NC 159—is shown as Exhibit I.

Instructions for Preparation of Report.

1. *The Carrier*—Name either in full or abbreviated should be filled in.
2. *Case Identification*—Each carrier should use its own claim number or any other method of identification so that it may later identify the case if necessary.
3. *Policy Year*—The Carrier should record the year of issue of the policy covering the case reported.
4. *State*—Record the state under whose workmen's compensation law the case was adjusted.
5. *Classification Code*—Give the code number of the classification to which the case was assigned.
6. *Sex*—Indicate by check mark whether male or female.
7. *Date of Birth*—Fill in the month, day and year of birth of the injured. If the date of birth is not available, give the age of the injured at date of accident. The dates in items 7-12 inclusive should, if possible, give the month, the day of the month, and the year.
8. *Date of Accident*—Fill in the date on which the accident occurred.
9. *Date Permanent Total Disability Began*—Fill in the date on which the total disability began.
10. *Date of Last Observation*—If the case is still open fill in the date on which the case was last observed as shown in your file.
11. *Date of Death*—Fill in the date on which the injured died.
12. *Date of Termination*—Fill in the date on which the case terminated according to your file. Check the method of termination in the proper blank.

13. *Nature of Injury*—Fill in the nature of injury as you would on the individual reports accompanying unit risks reports or Schedule "Z".
14. *Remarks*—Any special features that you think require clarification should be explained under remarks, using reverse side if necessary. In permanent partial cases, give degree of disability under "Remarks".

Compilation and Tabulation of Reports

The compensation insurance carriers filed the experience on form NC159 —see Exhibit I—with the National Council, except that a few carriers filed tabulator listings of the essential data. At the National Council these forms or listings were reviewed, coded, and recorded on punch cards from which all tabulations of the Committee were made.

From the punch cards the terminations of exposure and the deaths were tabulated for each age of entry, that is, the age of the injured at the time the case was first considered permanent total. This was the basic tabulation from which the data were entered on working sheets, one for each age of entry like that in Exhibit II for age at entry 25. The number of terminations not resulting from death was entered in column 2, the number of fatalities in column 3, and the number of months of exposure in the last year of observation for non-fatal cases was entered in column 5. In column 6 the exposures given in column 5 were expressed in terms of years. Column 4 shows the number of survivors for each year and is obtained by cumulating columns 2 and 3 upward. The number exposed at the beginning of each year of disability is obtained by adding columns 3, 4 and 6 as indicated in column 7.

The data in columns 3 and 7 from the work sheets—Exhibit II—were then transferred to Exhibit III, showing the number exposed at the beginning of the year and the fatalities during the year for each age of entry by select year of disability. By summing Exhibit III along the diagonal lines, omitting the first year of experience for each age, data were obtained for the form shown here as Exhibit IV, which gives the number exposed at the beginning of each year of age, the number that died during the year, and the crude mortality rate, with the first year of disability omitted from consideration because of inadequate reporting. Fractional year exposures resulting from terminations other than death are recorded as fractional numbers of persons exposed.

In feeling its way in the work the Committee did not proceed in all instances in as direct a manner as outlined. The first tabulations were made substantially as indicated. Later as more data were obtained more tabulations were made and the results were combined with those already made. In the Committee's investigation there were various tabulations, as by kind of injury, by industry, by geographical area, and by type of carrier.

Graduation of Mortality Rates

The crude mortality rates of Exhibit IV were adjusted at the ends where the exposure is sparse by averaging them with the U. S. Life Table—White Males—1930 mortality rates, using weights as shown in Exhibit V, preliminary to graduating. For each age over 73 the weight used was the ratio of the exposure of the given age to the exposure for age 73, the last year for which no adjustment was made. The complement weight was given to the U. S. 1930 mortality rate. For the ages under 22 the mortality rates of the U. S. Life Table were first raised to the general level of the mortality of the disabled lives by multiplying the U. S. Life rates by 9.1678, which is the factor by which the mortality rates of the U. S. 1930 table for ages 22-26 must be raised to reproduce the death experience among the disabled lives in the five year age group 22-26. The actual rates for ages under 22 were then adjusted by weighting them against the raised U. S. mortality rates, giving each actual rate a weight equal to the ratio of the exposure of the given age to the exposure for age 22, the earliest year used without adjustment, and giving the complement weights to the U. S. mortality rates. The crude mortality rates with the ends thus adjusted were graduated by using the Whittaker-Henderson technique as shown in Exhibit VI.

Comparison of Mortality Rates

The graduated mortality rates and the adjusted crude mortality rates are shown in graphical form in Exhibit VII.

Exhibit VIII is a comparison of the actual number of deaths and the expected number from graduated mortality rates. In column 3 are shown the expected deaths obtained by applying the graduated mortality rates column 4, Exhibit VI to the exposures column 2, Exhibit IV, by age. The actual fatalities column 3, Exhibit IV are shown in column 2. In columns 4 and 5 respectively the actual deaths and expected deaths are cumulated down for convenience in comparison.

In Exhibit IX is shown a comparison by five year age groups of the actual deaths with the expected deaths obtained by applying the mortality rates of six different tables to the exposure on which this investigation was based. The indexes in the last line show that when using the C. A. S. mortality rate as the standard of measure, the U. S. Life—1930 White Males shows a mortality rate of 69.3%; Hunter's Disabled Lives, 312.9%; Survivorship Annuitants, 56.3%; American Experience, 79.7%; and Standard Annuity, 49.0%.

EXHIBIT I

NATIONAL COUNCIL ON COMPENSATION INSURANCE

(In Cooperation with the Casualty Actuarial Society)

PERMANENT TOTAL DISABILITY REPORT

1.	Carrier _____				Leave this column blank
2.	Case Identification _____				
3.	Policy Year _____				_____
4.	State _____				_____
5.	Classification Code _____				_____
6.	Sex (check), Male ___ Female ___	Mo.	Day	Yr.	_____
7.	Date of Birth, if not available give age at date of accident _____	___	___	___	
8.	Date of Accident	___	___	___	
9.	Date Perm. Total Dis. Began	___	___	___	_____
	If case is still open				
10.	Date of last observation	___	___	___	_____
	If case is closed				
11.	Date of death if deceased	___	___	___	_____
12.	Date of termination	___	___	___	
	Method of termination (Check)				
	Died from Accident		_____		
	Recovered		_____		
	Followed by Perm. Partial		_____		
	Benefit Period ended		_____		
	Lump Sum Settlement		_____		
	Any Other (Explain in "Remarks")		_____		
13.	Nature of Injury				

14. Remarks

NC 189

EXHIBIT II

WORK SHEET FOR CALCULATION OF NUMBER EXPOSED AT BEGINNING OF EACH YEAR OF DISABILITY FOR AGE AT ENTRY 25

x Year of Disability	Number of Terminations		Number of Survivors $\Sigma\,[(2)_{x+1}+(3)_{x+1}]$	Exposure of Non-fatal Cases in last year of Observation		No. Exposed at Beginning of Year
	Non-fatal	Fatal		In Months	In Years	(3)+(4)+(6)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	—	—	20	0	.0	20.0
2	2	2	16	18	1.5	19.5
3	4	—	12	13	1.1	13.1
4	1	—	11	6	.5	11.5
5	2	—	9	18	1.5	10.5
6	—	1	8	0	.0	9.0
7	2	—	6	11	.9	6.9
8	3	—	3	10	.8	3.8
9	2	—	1	6	.5	1.5
10	—	—	1	0	.0	1.0
11	—	—	1	0	.0	1.0
12	—	—	1	0	.0	1.0
13	1	—	—	10	.8	.8
14	—	—	—	—	—	—
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						

Columns 2, 3, and 5 are filled in from the basic tabulation sheets; other columns are derived as indicated.

Exhibit III — Mortality for Disabled Lives Investigation. C. A. S.

Exposure Unit = 0.1 Man-Year — Territory ALL — Industry ALL — Injury ALL KINDS

Exposure at Start of Year, below – Fatals during year, above.

X Age at Entry	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	CHECK TOTALS
16	30	30	~0	~0	70	~0	~0	~0	~0	14	10	10	7													~41
17	50	41	30	30	~0	~0	~0	~0	19	10	5															1 ~73
18	50	50	50	30	30	~0	10	10	5																	1 ~55
19	120	120	10~	85	61	60	50	35	4																	3 637
20	80	80	78	64	56	45	~0	~0	12	9																464
21	140	1 ~7	108	83	7~	70	47	38	~5	~0	19	5														1 749
22	~10	~10	188	1 170	1 13~	1 91	70	64	40	38	3~	30	30	~6	~0	~0	18	10	4							3 1 403
23	~80	1 ~7	~07	194	171	158	132	1 59	~1	~1	~1	~1	~1	~0	1 10											3 1 559
24	~50	1 ~50	1 ~36	2 ~07	150	1 ~7	105	87	51	31	30	~~	~0	~0	~0	18	10	1 10								5 1 644
25	~00	2 195	131	115	105	1 90	69	38	15	10	10	10	8													3 996
26	310	~93	1 ~41	~07	190	178	1 155	129	91	1 61	50	1 50	36	30	1 30	~0	~0	~0	1 15							6 ~121
27	~04	177	1 170	117	100	1 97	65	55	40	30	17	6														2 1 073
28	1 3~8	305	1 ~83	~45	198	153	117	100	67	~8	10	8														2 1 85~
29	~68	~40	2 ~3~	1 173	116	9~	65	60	44	30	~8	1~	10	10	~											3 1 38~
30	353	1 33~	1 315	~14	3 ~3~	1 167	111	88	60	48	33	30	1 30	~	10	10	10	10	10	10	6					6 ~ 156

EXHIBIT IV

Mortality of Disabled Lives—Data of Exhibit III
Select Data—First Year of Disablement Omitted

(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Age	Exposed	Died	Mortality Rate	Age	Exposed	Died	Mortality Rate
15				65	113.0	5	.04425
16				66	121.7	5	.04108
17	3.0	—	.00000	67	123.4	7	.05673
18	6.1	1	.16393	68	121.2	4	.03300
19	10.0	—	.00000	69	116.6	5	.04288
20	22.0	1	.04545	70	115.9	2	.01726
21	26.0	—	.00000	71	113.2	7	.06184
22	35.5	1	.02817	72	103.0	11	.10680
23	50.3	—	.00000	73	95.3	6	.06296
24	66.2	2	.03021	74	80.8	6	.07426
25	83.7	3	.03584	75	67.2	8	.11905
26	90.7	5	.05513	76	60.7	5	.08237
27	97.9	3	.03064	77	53.0	9	.16981
28	97.1	1	.01030	78	45.5	6	.13187
29	113.9	1	.00878	79	39.5	3	.07595
30	113.9	3	.02634	80	34.0	2	.05882
31	134.1	3	.02237	81	30.8	6	.19481
32	136.8	3	.02193	82	22.8	4	.17544
33	135.3	—	.00000	83	18.1	2	.11050
34	146.0	6	.04110	84	16.3	1	.06135
35	148.8	3	.02016	85	13.1	3	.22901
36	158.3	1	.00632	86	8.7	1	.11494
37	177.3	2	.01128	87	5.9	—	.00000
38	186.5	5	.02681	88	3.0	1	.33333
39	195.5	4	.02046	89	2.0	—	.00000
40	205.3	3	.01461	90	2.0	—	.00000
41	210.9	2	.00948	91	2.0	1	.50000
42	209.3	2	.00956	92	1.0	—	.00000
43	224.9	4	.01779	93	1.0	—	.00000
44	233.5	6	.02570	94	1.0	1	1.00000
45	225.4	6	.02662		8597.7	285	
46	236.3	4	.01693				
47	230.2	6	.02606				
48	223.1	4	.01793				
49	213.5	6	.02810				
50	205.5	4	.01946				
51	229.0	9	.03930				
52	223.3	4	.01791				
53	229.9	5	.02175				
54	222.0	5	.02252				
55	208.8	6	.02874				
56	184.7	6	.03249				
57	173.3	6	.03462				
58	161.2	7	.04342				
59	150.9	2	.01325				
60	141.3	8	.05662				
61	131.5	6	.04563				
62	130.8	7	.05352				
63	115.4	5	.04333				
64	111.1	3	.02700				

EXHIBIT V

MORTALITY RATES OF DISABLED LIVES EXPERIENCE MERGED (FROM AGES 17 TO 21 INCLUSIVE AND FROM AGE 74 ON) WITH MORTALITY RATES OF U. S. LIFE TABLE 1-A 1930 WHITE MALES

(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Age	Disabled Lives Mortality Rates	Weight	U. S. Life, Table 1-A. 1930 Mortality Rates	Weighted Average	Age	Disabled Lives Mortality Rates	Weight	U. S. Life, Table 1-A. 1930 Mortality Rates	Weighted Average
10			.00147		60	.05662	100– 0	.02644	.05662
11			.00149		61	.04563	" "	.02838	.04563
12			.00157		62	.05352	" "	.03052	.05352
13			.00171		63	.04333	" "	.03297	.04333
14			.00190		64	.02700	" "	.03568	.02700
15			.00213		65	.04425	" "	.03865	.04425
16			.00241		66	.04108	" "	.04196	.04108
17	0	08–92	.02439*	.02244	67	.05673	" "	.04558	.05673
18	.16393	17–83	.02622*	.04963	68	.03300	" "	.04949	.03300
19	0	28–72	.02760*	.01987	69	.04288	" "	.05362	.04288
20	.04545	62–38	.02915*	.03926	70	.01726	" "	.05796	.01726
21	0	73–27	.03099*	.00837	71	.06184	" "	.06252	.06184
22	.02817	100– 0	.00353	.02817	72	.10680	" "	.06740	.10680
23	0	" "	.00361	0	73	.06296	100– 0	.07271	.06296
24	.03021	" "	.00366	.03021	74	.07426	85–15	.07861	.07491
25	.03584	" "	.00371	.03584	75	.11905	71–29	.08526	.10925
26	.05513	" "	.00375	.05513	76	.08237	64–36	.09274	.08610
27	.03064	" "	.00381	.03064	77	.16981	56–44	.10105	.13956
28	.01030	" "	.00390	.01030	78	.13187	48–52	.11013	.12057
29	.00878	" "	.00402	.00878	79	.07595	41–59	.11983	.10184
30	.02634	" "	.00413	.02634	80	.05882	36–64	.12997	.10436
31	.02237	" "	.00426	.02237	81	.19481	32–68	.14043	.15783
32	.02193	" "	.00442	.02193	82	.17544	24–76	.15117	.15699
33	0	" "	.00463	0	83	.11050	19–81	.16214	.15233
34	.04110	" "	.00486	.04110	84	.06135	17–83	.17333	.15429
35	.02016	" "	.00510	.02016	85	.22901	14–86	.18468	.19089
36	.00632	" "	.00535	.00632	86	.11494	09–91	.19618	.18887
37	.01128	" "	.00563	.01128	87	0	06–94	.20780	.19533
38	.02681	" "	.00597	.02681	88	.33333	03–97	.21967	.22308
39	.02046	" "	.00636	.02046	89	0	02–98	.23211	.22747
40	.01461	" "	.00679	.01461	90	0	02–98	.24550	.24059
41	.00948	" "	.00727	.00948	91	.50000	02–98	.26017	.26497
42	.00956	" "	.00776	.00956	92	0	01–99	.27629	.27353
43	.01779	" "	.00825	.01779	93	0	01–99	.29397	.29103
44	.02570	" "	.00874	.02570	94	1.00000	01–99	.31332	.32019
45	.02662	" "	.00929	.02662	95		0–100	.33445	.33445
46	.01693	" "	.00988	.01693	96		" "	.35745	.35745
47	.02606	" "	.01052	.02606	97		" "	.38243	.38243
48	.01793	" "	.01122	.01793	98		" "	.40951	.40951
49	.02810	" "	.01198	.02810	99		" "	.43879	.43879
50	.01946	" "	.01278	.01946	100		" "	.47037	.47037
51	.03930	" "	.01365	.03930	101		" "	.50436	.50436
52	.01791	" "	.01459	.01791	102		" "	.54087	.54087
53	.02175	" "	.01566	.02175	103		" "	.58001	.58001
54	.02252	" "	.01687	.02252	104		" "	.62187	.62187
55	.02874	" "	.01819	.02874	105		" "	.66656	.66656
56	.03249	" "	.01966	.03249					
57	.03462	" "	.02125	.03462					
58	.04342	" "	.02290	.04342					
59	.01325	100– 0	.02461	.01325					

*Mortality rate ×9.1678.

EXHIBIT VI

GRADUATION, BY WHITTAKER-HENDERSON FORMULA A, OF DISABLED LIVES MORTALITY RATES
(As Adjusted in Exhibit V)

Constants: $z=3$, $n=5$ in notation of T.A.S.A. XXXVIII p. 408

$$2352\ u'_x = 5600\ u'_{x-1} - 4560\ u'_{x-2} + 1260\ u'_{x-3} + 52\ u''_{x+5}$$

$$2352\ u_x = 5600\ u_{x+1} - 4560\ u_{x+2} + 1260\ u_{x+3} + 52\ u'_{x-5}$$

(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
x	u''_x	u'_x	u_x	x	u''_x	u'_x	u_x
9		.0410765					
10		.0393524		60	.05662	.0389782	.0367524
11		.0377305		61	.04563	.0403010	.0375765
12		.0360404		62	.05352	.0416266	.0383180
13		.0348384		63	.04333	.0425871	.0390713
14		.0337264	.0334760	64	.02700	.0432311	.0399711
15		.0329325	.0322622	65	.04425	.0430459	.0411742
16		.0318713	.0311505	66	.04108	.0428566	.0428373
17	.02244	.0307258	.0301409	67	.05673	.0441039	.0451067
18	.04963	.0290078	.0292334	68	.03300	.0463722	.0481051
19	.01987	.0272376	.0284280	69	.04288	.0495175	.0519201
20	.03926	.0258644	.0277317	70	.01726	.0540360	.0565821
21	.00837	.0255331	.0271469	71	.06184	.0593996	.0620559
22	.02817	.0259168	.0266677	72	.10680	.0662767	.0682407
23	0	.0262874	.0262656	73	.06296	.0742527	.0750058
24	.03021	.0262148	.0258922	74	.07491	.0823693	.0822266
25	.03584	.0259172	.0254808	75	.10925	.0899707	.0897853
26	.05513	.0254601	.0249718	76	.08610	.0977880	.0975827
27	.03064	.0249001	.0243341	77	.13956	.1059929	.1055568
28	.01030	.0238087	.0235772	78	.12057	.1143415	.1136834
29	.00878	.0229597	.0227358	79	.10184	.1225428	.1219873
30	.02634	.0222913	.0218485	80	.10436	.1310883	.1305225
31	.02237	.0214552	.0209486	81	.15783	.1399621	.1393459
32	.02193	.0204152	.0200679	82	.15699	.1490588	.1485097
33	0	.0195453	.0192360	83	.15233	.1587047	.1580774
34	.04110	.0189021	.0184786	84	.15429	.1688856	.1681232
35	.02016	.0183708	.0178140	85	.19089	.1795879	.1787235
36	.00632	.0177734	.0172673	86	.18887	.1910375	.1899535
37	.01128	.0170382	.0168636	87	.19533	.2031924	.2018967
38	.02681	.0163433	.0166194	88	.22308	.2160547	.2146432
39	.02046	.0159690	.0165439	89	.22747	.2298921	.2282889
40	.01461	.0160516	.0166453	90	.24059	.2447280	.2429409
41	.00948	.0163874	.0169280	91	.26497	.2606229	.2587149
42	.00956	.0170281	.0173859	92	.27353	.2776696	.2757336
43	.01779	.0177671	.0179979	93	.29103	.2959869	.2941272
44	.02570	.0186892	.0187300	94	.32019	.3157122	.3140280
45	.02662	.0196041	.0195543	95	.33445	.3369945	.3355672
46	.01693	.0208292	.0204451	96	.35745	.3599880	.3588746
47	.02606	.0219934	.0213875	97	.38243	.3848471	.3840725
48	.01793	.0229652	.0223742	98	.40951	.4117228	.4112707
49	.02810	.0236952	.0234057	99	.43879	.4407598	.4405627
50	.01946	.0243104	.0244861	100	.47037	.4720950	.4720235
51	.03930	.0249633	.0256229	101	.50436	.5057284	.5057090
52	.01791	.0257633	.0268228	102	.54087	.5416600	.5416570
53	.02175	.0269264	.0280917	103	.58001	.5798898	.5798898
54	.02252	.0278274	.0294226	104	.62187	.6204178	.6204178
55	.02874	.0291050	.0307913	105	.66656	.6632440	.6632440
56	.03249	.0307802	.0321581				
57	.03462	.0329489	.0334758	$\sum_{17}^{x=105}$			
58	.04342	.0353238	.0346995		10.77520		10.7749718
59	.01325	.0373101	.0357960				

EXHIBIT VII

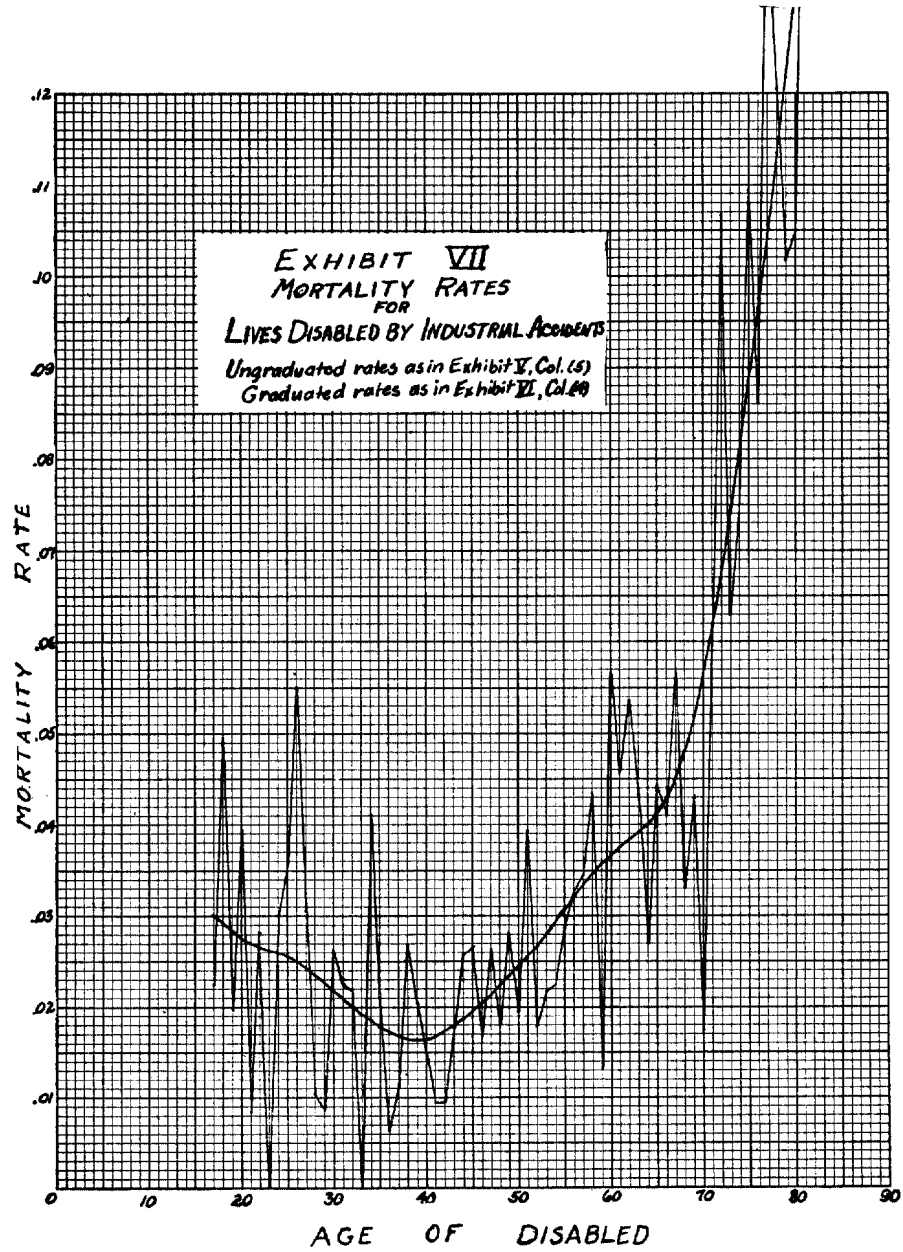
EXHIBIT VII
MORTALITY RATES
FOR
LIVES DISABLED BY INDUSTRIAL ACCIDENTS
Ungraduated rates as in Exhibit V, Col. (5)
Graduated rates as in Exhibit VI, Col. (4)
MORTALITY RATE
.12
.11
.10
.09
.08
.07
.06
.05
.04
.03
.02
.01
0
10
20
30
40
50
60
70
80
90
AGE OF DISABLED

EXHIBIT VIII

COMPARISON OF ACTUAL NUMBER OF DEATHS AND EXPECTED NUMBER FROM GRADUATED MORTALITY RATES — COLUMN 4, EXHIBIT VI.

Column 2—Actual number of deaths
Column 3—Expected number from graduated rates
Column 4—Actual number cumulated down
Column 5—Expected number cumulated down

Age	Number Deaths		Col.2 Cum.	Col.3 Cum.	Age	Number Deaths		Col.2 Cum.	Col.3 Cum.
	Actual	Expected				Actual	Expected		
(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
15	-	-	-	-	55	6	6.4	124	124.9
6	-	-	-	-	6	6	5.9	130	130.8
7	-	.1	-	.1	7	6	5.8	136	136.6
8	1	.2	1	.3	8	7	5.6	143	142.2
9	-	.3	1	.6	9	2	5.4	145	147.6
20	1	.6	2	1.2	60	8	5.2	153	152.8
1	-	.7	2	1.9	1	6	4.9	159	157.7
2	1	.9	3	2.8	2	7	5.0	166	162.7
3	-	1.3	3	4.1	3	5	4.5	171	167.2
4	2	1.7	5	5.8	4	3	4.4	174	171.6
25	3	2.1	8	7.9	65	5	4.7	179	176.3
6	5	2.3	13	10.2	6	5	5.2	184	181.5
7	3	2.4	16	12.6	7	7	5.6	191	187.1
8	1	2.3	17	14.9	8	4	5.8	195	192.9
9	1	2.6	18	17.5	9	5	6.1	200	199.0
30	3	2.5	21	20.0	70	2	6.6	202	205.6
1	3	2.8	24	22.8	1	7	7.0	209	212.6
2	3	2.7	27	25.5	2	11	7.0	220	219.6
3	-	2.6	27	28.1	3	6	7.1	226	226.7
4	6	2.7	33	30.8	4	6	6.6	232	233.3
35	3	2.7	36	33.5	75	8	6.0	240	239.3
6	1	2.7	37	36.2	6	5	5.9	245	245.2
7	2	3.0	39	39.2	7	9	5.6	254	250.8
8	5	3.1	44	42.3	8	6	5.2	260	256.0
9	4	3.2	48	45.5	9	3	4.8	263	260.8
40	3	3.4	51	48.9	80	2	4.4	265	265.2
1	2	3.6	53	52.5	1	6	4.3	271	269.5
2	2	3.6	55	56.1	2	4	3.4	275	272.9
3	4	4.0	59	60.1	3	2	2.9	277	275.8
4	6	4.4	65	64.5	4	1	2.7	278	278.5
45	6	4.4	71	68.9	85	3	2.3	281	280.8
6	4	4.8	75	73.7	6	1	1.7	282	282.5
7	6	4.9	81	78.6	7	-	1.2	282	283.7
8	4	5.0	85	83.6	8	1	.6	283	284.3
9	6	5.0	91	88.6	9	-	.5	283	284.8
50	4	5.0	95	93.6	90	-	.5	283	285.3
1	9	5.9	104	99.5	1	1	.5	284	285.8
2	4	6.0	108	105.5	2	-	.3	284	286.1
3	5	6.5	113	112.0	3	-	.3	284	286.4
4	5	6.5	118	118.5	4	1	.3	285	286.7

EXHIBIT IX

COMPARISON OF ACTUAL DEATHS WITH EXPECTED DEATHS UNDER VARIOUS MORTALITY TABLES. BASED ON EXPOSURE—COL. (2)—UNDERLYING CASUALTY ACTUARIAL SOCIETY MORTALITY TABLE

			EXPECTED DEATHS					
Age Group	Exposure	Actual Deaths	C.A.S. Disabled Lives	U.S. Life 1930 White Males	Hunter's Disabled Lives	Survivorship Annuitants	American Experience	1937 Standard Annuity
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
15-19	19.1	1	.6	-	4.3	.1	.1	-
20-24	200.0	4	5.2	.7	35.3	1.1	1.6	.2
25-29	483.3	13	11.7	1.9	63.2	2.6	3.9	.8
30-34	666.1	15	13.3	3.0	64.0	4.0	5.8	1.5
35-39	866.4	15	14.7	4.9	75.7	5.5	8.0	3.0
40-44	1 083.9	17	19.0	8.4	92.6	7.9	11.1	5.6
45-49	1 128.5	26	24.1	11.9	99.8	9.7	13.6	8.3
50-54	1 109.7	27	29.9	16.3	104.9	12.2	17.2	12.1
55-59	878.9	27	29.1	18.5	91.9	13.1	18.7	13.7
60-64	630.1	29	24.0	19.2	71.5	13.5	19.7	14.5
65-69	595.9	26	27.4	27.4	68.5	19.7	28.6	20.0
70-74	508.2	32	34.3	34.0	58.9	26.0	37.1	24.4
75-79	265.9	31	27.5	26.4	32.5	21.6	29.1	18.4
80-84	122.0	15	17.7	17.8	20.7	15.6	20.7	12.1
85-89	32.7	5	6.3	6.5	9.0	6.4	9.0	4.4
90-94	7.0	2	1.9	1.9	4.2	2.3	4.2	1.4
15-94	8 597.7	285	286.7	198.8	897.0	161.3	228.4	140.4
Index		.994	1.000	.693	3.129	.563	.797	.490