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An investigation into the effects of Family and Personal History upon the rates of mortality experienced in various classes of Life Assurance risks, with special reference to Tuberculosis.

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[Read before the Institute, 28 April 1913.]

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Introduction. An investigation into the effects of family and personal history upon assurance risks has long been desired by Actuaries, but hitherto in this country the material at their disposal has not been sufficient in volume to admit of analytical treatment. The only attempt the Institute as a body has made to deal with this subject is in the old Institute experience, which contains the records of 11,146 rated-up lives, in which all kinds of risks are combined without any attempt at classification.

Object of Investigation.

In the hope that this long-felt want might, to some extent, be met, an investigation was projected into the experience of a large number of lives assured in the Ordinary Branch of the Prudential Assurance Company whose family or personal history showed some marked peculiarity, by means of which they could be separated into more or less well-defined classes. The actual work of compiling the necessary data was commenced in 1903, and by the courteous permission and public-spirited action of the Directors we have now the pleasure of placing the main results of that investigation before the Institute. No claim is made in this Paper either to exhaustive analysis or to complete solution of the numerous and important problems that arise in practice, but it is thought that, at least, the results may form a useful aid to the Actuary in arriving at those conclusions which necessarily have to be formed—mainly from *a priori* reasoning—when risks come before him for adjudication.

Actuarial and Medical Standpoint.

That is to say, the primary object of the enquiry was to exhibit the experience in such a way as to enable the results to be applied practically in the assessment of risks. In regard to this it must be pointed out that the actuary has not altogether the same object in view as the doctor. The former is concerned mainly, if not entirely, with the financial result, so that what concerns him is the way in which a number of lives—fairly homogeneous in family and personal history—are subjected to special rates of mortality; at what age-group or groups that special rate first begins to show itself; and throughout what age-period it exists. The doctor, on the other hand, has in mind, to a large extent, the resulting benefits to humanity in the alleviation, and it may be even the elimination, of causes that tend to increase the death roll. He would thus seek for some light to be thrown on the causes themselves, as well as on the period of life at which they exert their most powerful influence. Too much of purely medical interest must not be expected, then, from the statistics given, though it is hoped that some light may be thrown upon some important problems—such as the effect on mortality of family and personal history, and the age-incidence of various causes of death.

Source of Data.

The information on the Office valuation cards was sufficient to indicate any defect, either in the family history or personal condition, where it existed, thus rendering it possible to pick out all the cases required; but, unfortunately, the

actual nature of the defect was not specified. To remedy this it was necessary to examine the actual proposal papers. The observations started with policies existing in 1893, and Valuations Cards of all kinds from that date onwards—whether existing, discontinued, or died—were carefully gone through to ensure the whole of the required data being brought into account.

A continuous record was maintained until it was thought that a sufficiently large body of data had accumulated, the observations eventually being closed on 31 December 1910. As those surviving at the commencement were brought under observation on their policy anniversaries in 1893, and the existing at the close were in similar manner taken to their policy anniversaries in 1910, the utmost period of observation in any one case was 17 policy-years.

Classification of Data.

The particulars having been filled in from the valuation cards, the experience cards were submitted together with the original proposal papers, to the Company's Medical Officer—the late Dr. E. M. Light—for classification according to the class of risk. The death of Dr. Light, after he had expended so much time and thought on the investigation and before he could see the fruit of his labours in its completion, was particularly untimely. Not only was the classification made according to a plan formulated by him, but every individual case passed through his hands. Had he lived to record the ripe experience thus gained, many obscure points would, doubtless, have been elucidated. The enormous volume of work he undertook in this connection may be appreciated from the fact that the records of the 140,898 policies included in the experience were all scrutinized and classified by him personally, in addition to which he was continuing the records down to the time of his death.

The classification adopted was based broadly on Bertillon's system, an adaptation of which by Melville-Dewey was described in Dr. Carruthers' Paper, read before this Institute in April 1905, the extreme elaboration suggested by the latter, however, being avoided. At the outset the basis was determined by *a priori* reasoning, modifications or extensions being made as the work proceeded. The main groupings were indicated by letters of the Alphabet, subsidiary sub-groupings being indicated by Numerals. The form which this classification finally took is given in the following Table of Classification. As it was necessarily pre-

pared before it was possible to know whether the extent of the data would permit of sufficient facts being obtained in the respective sub-groups, it is not a matter for surprise that a large number of the groups could not be dealt with, owing to the paucity of data.

Table of Classification.

A.—Relatives who died of consumption or childbirth.

0. Some distant relative, such as uncle or grandfather.

(α) *Lineals.*

1. Father only.
2. Mother only (consumption).
3. Mother only (childbirth).
4. Father and mother (consumption).

(β) *Lineals plus Collaterals.*

5. Father and brother or sister (consumption).
6. Mother and brother or sister (consumption).
7. Mother (childbirth) and sister (childbirth).
8. Mother (childbirth) and brother or sister (consumption).
9. Father and mother, and brother or sister (consumption).

(γ) *Collaterals.*

10. Sister (childbirth).
11. One brother or sister (consumption).
12. Two or more brothers or sisters (consumption).

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13. Family History associated with some pulmonary disease, other than that of a tuberculous character.
14. Unknown Family History.
15. Obscure Family History.

B.—Personal History of Rheumatic Fever, and Lesions of the Circulatory System.

1. Rheumatic Fever (without acquiring Morbus Cordis).
2. Rheumatic Fever (with secondary Morbus Cordis).
3. Some form of Heart Disease without a history of Rheumatism or Rheumatic Fever.
4. Family History with three or more cases of Morbus Cordis.
5. Irregular or intermittent Pulse only.
6. Tachycardia.

7. Weak Heart.
8. Fatty Heart.
9. Hypertrophied Heart (without a valvular lesion).
10. Dilated Heart.
11. Bradycardia.
12. Heart functionally deranged through abuse of Tobacco.
13. Pericarditis.
14. Arterio-Sclerosis.
15. Aneurism.
16. Angina pectoris.

C.—Relatives who died of Cancer. (Two cases or more.)

(*a*) *Lineals.*

1. Father and mother.

(*β*) *Lineals plus Collaterals.*

2. Father and brother or sister.
3. Mother and brother or sister.
4. Father and mother, and brother or sister.

(*γ*) *Collaterals.*

5. Two or more brothers or sisters.

D.—Obesity.
E.—Some personal blemish other than already tabulated.
F.—Formerly intemperate.
G.—Gouty Diathesis.
1. Family History of Gout.
H.—History of Glycosuria.
1. Family History of Diabetes.
I.—History of Asthma.
1. Family History of Asthma.
K.—Family History associated with diseases of the Nervous System—Mental or Spinal.
M.—Alcoholic Family History. (Two cases.)
N.—Apoplectic Family History. (Two cases.)
S.—Syphilitic Family History.
Z.—History of Zymotic disease.
1. Typhoid Fever.
2. Malarial Fever.
3. Scarlet Fever.
4. Influenza.
5. Dysentery.

In any case where the life belonged to more than one class the matter of treatment received careful consideration, and a small number of such cases were excluded altogether. Those that were retained consisted mainly of lives that combined a family history of tuberculosis with some personal blemish, indicated in the results as Group A+E. The rest were in Group E, the double taint referring to sub-groups of the same class. Throughout the observations, whole-life cases were kept distinct from endowment assurances, and, in addition, the sexes were distinguished. It is to be regretted that, even in so large an experience, the data both for whole-life assurances on male lives and for assurances on female lives, were often too small for the deduction of detailed conclusions.

Classification of Causes of Death.

It was thought that some useful information might be obtained from an analysis of the causes of death. For this purpose some standard of grouping was necessary, and, upon consideration, the list on page 7 was drawn up by Dr. Light, based mainly on the Registrar-General's classification. The numerical index was added to facilitate tabulation.

Actuarial Treatment of Data.

The advantages of tabulating in "select" form are obvious, and in order to give effect to this, the data were tabulated in all cases according to duration of assurance, and in the final tables the analysis was retained as far as the first ten years following entry. In the principal groups additional tabulations were made in full aggregate form, and also in truncated form, eliminating the first five and the first ten years of assurance. In order to facilitate this the policy-year system was adopted. Fractional periods of exposure were eliminated by the adoption of the nearest duration method for withdrawals, and the existing were traced to their policy anniversaries in 1910. For the deaths the curtate duration was taken. No attempt was made to eliminate duplicates, as it was felt that the effect of their exclusion would not be sufficient to warrant the extra labour involved.

Age at Entry.

The age at entry was taken throughout as the Office Age, that is to say, the age next birthday. It was felt that this was quite sufficient for the purpose in view. The work was considerably simplified thereby, and as quinquennial age-groups had ultimately to be employed, the use of a method involving further labour seemed an unnecessary refinement.

Table of Causes of Death.

Infective Diseases	1 Enteric Fever (Typhoid)—Dysentery—Diarrhœa (not otherwise defined)—Cerebro-Spinal Fever — Diphtheria — Erysipelas—Malaria, and other infective processes. 2 Pyæmia (not puerperal) — Septicæmia—Septic Intoxication. 3 Influenza.
Tuberculosis (all forms)	4 Phthisis—Pulmonary Tuberculosis—Tuberculosis of Spine and Joints—Tuberculosis of other organs.
Alcoholism	5 Alcoholism — Delirium Tremens — Cirrhosis of liver.
Other General Diseases	6 Rheumatic Fever-Acute Rheumatism-Chronic Rheumatism—Gout—Osteoarthritis. 7 Carcinoma—Sarcoma. 8 Anæmia-Leucocythemia--Pernicious Anæmia. 9 Diabetes Mellitus.
Diseases of the Nervous System	10 Paralysis—General Paralysis of the Insane—Locomotor Ataxia — Neuritis — Epilepsy—Meningitis, and other diseases of the Nervous System.
Diseases of the Heart	11 Valvular Disease — Pericarditis — Angina Pectoris—Syncope—Fatty Degeneration of the Heart, and other organic diseases of the Heart.
Diseases of Blood-Vessels	12 Cerebral Hæmorrhage—Apoplexy—Arterio-Sclerosis. 13 Embolism — Thrombosis — Phlebitis—and other diseases of the blood-vessels 14 Aneurism.
Diseases of Respiratory System	15 Laryngitis — Bronchitis — Emphysema — Asthma—Congestion of Lungs, and other diseases of Respiratory System (not otherwise grouped). 16 Pneumonia—Pleurisy and Empyema.
Diseases of Digestive System	17 Quinsy—Gastric Ulcer—Gastritis—Enteritis and other diseases of the Digestive System. 18 Appendicitis and Perityphlitis. 19 Hernia. 20 Intestinal obstruction. 21 Peritonitis. 22 Diseases of the Liver—Gall-stones.
Diseases of Urinary System	23 Acute and chronic Nephritis (Bright's disease)—Renal Calculus, and other diseases of the Kidney. 24 Diseases of the Bladder, Prostate and Urethra.
Diseases of the Female Generative System	25 Fibroid Tumour of the Uterus, and other diseases (not malignant) of the Uterus and Ovaries.
Diseases of Pregnancy and Childbirth	26 Childbirth — Abortion — Miscarriage — Puerperal Mania, and other accidents of pregnancy and childbirth.
Other Specified Diseases	27 Lymphadenoma (Hodgkin's disease)—Raynaud's disease—Grave's disease—Plumbism, and other specified diseases.
Ill-defined or not Specified Diseases	28 Debility—Old age—Dropsy—Tumour, and other ill-defined causes.
Suicide	29
Accident	30

Summary of Data.

To assist in forming some idea of the weight to be attached to the observations, Tables I to VII, giving a general summary of the data, are here set out.

Table I.

Summary of Data.

Whole-Life Assurances. *Males.*

Group (1)	Entrants: Survivors (2)	Entrants: New Entrants (3)	Entrants: Total (4)	Deaths (5)	Average duration during period of observation (6)
A_0 to A_{12} ...	3,534	6,369	9,903	1,434	8·91
A_{13}	65	751	816	79	7·73
A_{14} and A_{15} ...	533	1,917	2,450	343	8·11
A + other cause...	326	621	947	201	9·58
B	938	736	1,674	509	9·88
C	16	147	163	15	5·34
D	233	1,666	1,899	440	7·00
E	1,311	1,856	3,167	762	9·21
F	358	332	690	262	8·70
G	160	214	374	147	8·22
Total	7,474	14,609	22,083	4,192	8·71

Table II

Summary of Data.

Endowment Assurances. *Males.*

Group (1)	Entrants: Survivors (2)	Entrants: New Entrants (3)	Entrants: Total (4)	Deaths (5)	Average duration during period of observation (6)
A_0 to A_{12} ...	7,393	48,372	55,765	2,424	7·36
A_{13}	86	2,855	2,941	102	4·70
A_{14} and A_{15} ...	790	7,918	8,708	450	6·00
A + other cause...	703	3,112	3,815	297	9·52
B	1,359	3,401	4,760	368	8·06
C	17	542	559	26	5·32
D	139	3,087	3,226	292	6·62
E	1,513	8,159	9,672	640	7·01
F	391	637	1,028	138	7·93
G	67	245	312	51	6·62
Total	12,458	78,328	90,786	4,788	7·20

Table III.

Summary of Data.

Whole-Life Assurances. *Females.*

Group (1)	Entrants: Survivors (2)	Entrants: New Entrants (3)	Entrants: Total (4)	Deaths (5)	Average duration during period of observation (6)
A_0 to A_{12} ...	753	1,398	2,151	322	8·76
A_{13}	21	207	228	23	7·61
A_{14} and A_{15} ...	140	511	651	95	8·00
A + other cause...	50	111	161	45	9·01
B	177	147	324	131	9·31
C	7	44	51	9	6·69
D	141	863	1,004	235	7·45
E	332	427	759	221	9·12
Total	1,621	3,708	5,329	1,081	8·44

Table IV.

Summary of Data.

Endowment Assurances. *Females.*

Group (1)	Entrants: Survivors (2)	Entrants: New Entrants (3)	Entrants: Total (4)	Deaths (5)	Average duration during period of observation (6)
A_0 to A_{12} ...	1,877	12,144	14,021	549	7·48
A_{13}	22	736	758	31	4·77
A_{14} and A_{15} ...	153	1,893	2,046	74	5·83
A + other cause ..	127	799	926	67	8·72
B	287	733	1,020	66	7·66
C	8	157	165	2	6·05
D	81	911	992	103	7·35
E	452	2,320	2,772	156	7·24
Total	3,007	19,693	22,700	1,048	7·25

Table V.

Summary of Data. *Males.*

Group (1)	Whole-Life Assurances		Endowment Assurances		Total	
	Exposed (2)	Deaths (3)	Exposed (4)	Deaths (5)	Exposed (6)	Deaths (7)
A_0 to A_{12} ...	88,219	1,434	410,551	2,424	498,770	3,858
A_{13}	6,311	79	13,828	102	20,139	181
A_{14} and A_{15} ...	19,866	343	52,257	450	72,123	793
A + other cause...	9,073	201	36,307	297	45,380	498
B	16,536	509	38,379	368	54,915	877
C	871	15	2,975	26	3,846	41
D	13,287	440	21,350	292	34,637	732
E	29,161	762	67,799	640	96,960	1,402
F	6,001	262	8,148	138	14,149	400
G	3,074	147	2,065	51	5,139	198
Total	192,399	4,192	653,659	4,788	846,058	8,980

Table VI.

Summary of Data. *Females.*

Group (1)	Whole Life Assurances		Endowment Assurances		Total	
	Exposed (2)	Deaths (3)	Exposed (4)	Deaths (5)	Exposed (6)	Deaths (7)
A_0 to A_{12} ...	18,838	322	104,854	549	123,692	871
A_{13}	1,735	23	3,619	31	5,354	54
A_{14} and A_{15} ...	5,208	95	11,936	74	17,144	169
A + other cause...	1,451	45	8,076	67	9,527	112
B	3,018	131	7,811	66	10,829	197
C	341	9	998	2	1,339	11
D	7,479	235	7,290	103	14,769	338
E	6,924	221	20,076	156	27,000	377
Total	44,994	1,081	164,660	1,048	209,654	2,129

TABLE VII.

Summary of Data. *Both Sexes.*

Group (1)	Whole-Life Assurances		Endowment Assurances		Total	
	Exposed (2)	Deaths (3)	Exposed (4)	Deaths (5)	Exposed (6)	Deaths (7)
A_0 to A_{12} ...	107,057	1,756	515,405	2,973	622,462	4,729
A_{13}	8,046	102	17,447	133	25,493	235
A_{14} and A_{15} ...	25,074	438	64,193	524	89,267	962
A + other cause ..	10,524	246	44,383	364	54,907	610
B	19,554	640	46,190	434	65,744	1,074
C	1,212	24	3,973	28	5,185	52
D	20,766	675	28,640	395	49,406	1,070
E	36,085	983	87,875	796	123,960	1,779
F	6,001	262	8,148	138	14,149	400
G	3,074	147	2,065	51	5,139	198
Total	237,393	5,273	818,319	5,836	1,055,712	11,109

It will be seen that Group A, consisting of cases having a family history of tuberculosis, is by far the largest. The great preponderance of endowment assurances is very noticeable, the total years of life under this class on male lives in Groups A_0 to A_{12} (where there is some definite family history of tuberculosis) amounting to no less than 410,551, the corresponding deaths being 2,424. The magnitude of the data in this group rendered it possible to make a fairly detailed analysis of the sub-groups and to place confidence in the results.

In other groups detailed analysis was not feasible, and groups H, I, K, M, N, S, and Z did not afford sufficient data to warrant investigation.

History of Cancer.

To this list of massacred innocents must, unfortunately, be added Group C, in which there was a family history of cancer. In view of the importance, at the present time, of statistics throwing any light whatever upon this disease, it is much to be regretted that the number of cases were so few, amounting in all to 938 only. The total years of life amounted only to 5,185, so that, in addition to paucity of data, there is a lack of extended duration in the very class in which long periods of exposure might be expected to teach some useful lessons. It may, however, be noted that of the 52 deaths recorded, 11 were due to cancer and 6 to phthisis. Of 11 deaths from all causes amongst female lives, 5 were due to cancer. Comparatively large as the data are in total in the groups

A, B, D, E, F and G, they are insufficient to admit of the construction or graduation of full Select Tables.

Aggregate Data.

Tables showing the exposed to risk and deaths in the main groups of the experience are furnished in an Appendix in the form of Full Aggregate and Truncated Aggregate Tables. It is hoped that the information there given may assist those who desire to further investigate the questions raised in the Paper.

The O[M] as a Standard of Comparison.

It was thought that the best way of showing results was by a comparison of the actual deaths with those expected according to some standard Table. The standard adopted was the O[M]. There are certain obvious advantages in using this Table. Not only is it, at the present time, the recognized standard of mortality amongst healthy lives assured under whole-life policies, but the rates of mortality during the first ten years of assurance were readily available for measuring the corresponding rates in the various groups.

It may here be stated that the expected deaths were calculated by multiplying the total exposed to risk in quinquennial groups of age by the appropriate value of q_x for the central age of the group. Investigation was made in a number of cases to determine the error introduced by this process, and it was found to be of no practical importance. In a few cases at the extremities of the Tables where the exposed to risk were increasing or decreasing rapidly the expected deaths were calculated for each individual age.

Light Mortality under Endowment Assurances.

The O[M] Table, however, has the defect of relating only to whole-life assurances, whereas in the present experience a great preponderance of the cases were under endowment assurances. Upon investigation it was found, as shown in Table VIII., that the actual deaths in the British Offices' Endowment Assurance Experience, Male Lives, New Assurances (O[EM]) during the first 10 years of assurance, were only 75 per-cent of the expected deaths calculated by the O[M] Table ; after the expiration of 10 years the percentage increases with the age attained up to age 45, after which age it is practically a constant ratio of about 83 per-cent.

The opinion has been expressed that the light rate of mortality shown by the British Offices' experience under endowment assurances would not be a permanent feature of the experience of this class of assurance, as it was thought that the self-selection which had undoubtedly been operative in former times would

not be maintained, seeing that endowment assurances have to a large extent replaced whole-life assurances in modern practice. The same feature is, however, observed in such a marked degree in the present investigation that we are inclined to think that it is of a more permanent character than has been generally believed to be the case. Thus, whilst the O[M] has, for the sake of convenience, been retained throughout as the standard of comparison, a sufficiently accurate estimate of the effect of employing the British Offices' endowment assurance experience as a standard may be obtained by taking the expected deaths as three-fourths of those tabulated, or the percentages of actual deaths to those expected as increased by one-third.

TABLE VIII.

Comparison of Actual Deaths in the British Offices' Endowment Assurance Experience (1863–1893) (*Males*), *with those expected according to* O[M] *Table.*

(A) *First* 10 *years of assurance. (New Assurances only).*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
–37	2008·2	1506	**75·0**	1452·1	1088	**74·9**	3460·3	2594	**75·0**
38–52	523·5	393	**75·1**	421·3	302	**71·7**	944·8	695	**73·6**
Total	2531·7	1899	**75·0**	1873·4	1390	**74·2**	4405·1	3289	**74·7**

(B) *Ultimate Table, excluding first* 10 *years of assurance. (Combined Old and New Assurances).*

Central Age Attained	Expected Deaths by O[M] Ultimate.		Actual Deaths		Percentage	
(1)	(2)		(3)		(4)	
35	281·0		201		**71·5**	
40	498·0		391		**78·5**	
45	641·2		532		**83·0**	
50	632·5		526		**83·2**	
55	516·1		408		**79·1**	
60	255·7	825·3	229	681	**89·6**	**82·5**
65	53·5		44		**82·2**	
Total	2878·0		2331		**81·0**	

Family History of Tuberculosis.

Tuberculosis. Combined Experience.

Coming now to the actual groups, the first to be dealt with is that containing a family history of tuberculosis, *i.e.*, Group A. To obtain a first general impression, sub-groups A_0 to A_{12}, which include all cases showing a definite family history of tuberculosis, were combined. Sub-groups A_{13}, A_{14}, and A_{15} were dealt with separately, as the family history is not of quite the same definite character.

Tables IX and X show the combined experience on male lives for each of the first ten years of assurance; Table IX referring to whole-life, and Table X to endowment assurances. The data for female lives were too small to show any useful result when set out in such detail. Each central age at entry is shown, and summaries are given for central age-groups 20 to 35 (*i.e.*, ages at entry 18 to 37), 40 to 50 (*i.e.*, ages at entry 38 to 52), and 55 to 60 (*i.e.*, ages at entry 53 to 62). A final summary is also given for all ages at entry. These summary age-groups were chosen as it was found that they best enabled the general trend of the curves to be seen.

For each of the ten years of assurance the deaths expected according to the $O^{[M]}$ Table are shown in one column, and the corresponding actual deaths in the next succeeding column. In addition, for each of the summary age-groups the percentages of actual to expected deaths are set out in distinctive type.

Family History of Tuberculosis. Combined Experience A_0 to A_{12}.

Whole-Life Assurances — *Comparison of Actual Deaths with those expected according to $O^{[M]}$ Table* — *Males.*

Central Age at Entry	Years of Assurance																						Central Age at Entry
	0		1		2		3		4		5		6		7		8		9		0–9			
	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Percentage of Actual to Expected Deaths	
(1)	(2)	(3)	(4)	5	(6	7	(8)		(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
20	·2	...	·3	2	·4	...	·4	4	·4	...	·5	...	·5	...	·6	1	·6	1	·6	2	4·5	10	**222·2**	20
25	1·4	1	2·1	2	2·4	4	2·5	3	2·6	3	2·7	4	2·9	5	3·0	1	3·2	4	3·3	3	26·1	30	**114·9**	25
30	2·9	5	4·3	9	4·8	7	5·0	8	5·4	4	6·0	6	6·5	9	6·8	9	7·0	6	7·5	7	56·2	70	**124·6**	30
35	4·1	10	5·8	11	6·8	14	7·3	12	7·7	9	8·4	7	9·2	9	10·0	15	10·5	7	10·9	12	80·7	106	**131·4**	35
20–35	8·6	16	12·5	24	14·4	25	15·2	27	16·1	16	17·6	17	19·1	23	20·4	26	21·3	18	22·3	24	167·5	216		20–35
Per-centage	**186·0**		**192·0**		**173·6**		**177·6**		**99·4**		**96·6**		**120·4**		**127·5**		**84·5**		**107·6**		**129·0**		**129·0**	Per-centage
40	4·9	10	6·5	15	7·2	8	7·7	13	8·1	7	8·8	8	9·7	14	10·2	11	10·7	9	11·2	15	85·0	110	**129·4**	40
45	6·3	8	8·3	10	9·5	12	10·1	16	11·0	15	11·6	9	12·1	12	12·9	14	13·3	11	13·9	5	109·0	112	**102·8**	45
50	6·1	9	7·3	7	8·1	7	8·4	8	9·0	11	9·4	8	10·0	16	10·4	14	10·4	9	10·4	13	89·5	102	**114·0**	50
40–50	17·3	27	22·1	32	24·8	27	26·2	37	28·1	33	29·8	25	31·8	42	33·5	39	34·4	29	35·5	33	283·5	324		40–50
Per-centage	**156·1**		**144·8**		**108·9**		**141·2**		**117·4**		**83·9**		**132·1**		**116·4**		**84·3**		**93·0**		**114·3**		**114·3**	Per-centage
55	3·0	3	3·4	5	3·7	4	3·8	1	3·9	3	3·9	1	4·2	4	4·4	4	4·3	4	4·0	4	38·6	33	**85·5**	55
60	·7	1	·9	...	·9	2	1·0	...	1·0	...	1·2	3	1·3	1	1·6	1	1·5	2	1·6	3	11·7	13	**111·1**	60
55–60	3·7	4	4·3	5	4·6	6	4·8	1	4·9	3	5·1	4	5·5	5	6·0	5	5·8	6	5·6	7	50·3	46		55–60
Per-centage	**108·1**		**116·3**		**130·4**		**20·8**		**61·2**		**78·4**		**90·9**		**83·3**		**103·4**		**125·0**		**91·5**		**91·5**	Per-centage
Total	29·6	47	38·9	61	43·8	58	46·2	65	49·1	52	52·5	46	56·4	70	59·9	70	61·5	53	63·4	64	501·3	586	**116·9**	Total
Per-centage	**158·8**		**156·8**		**132·4**		**140·7**		**105·9**		**87·6**		**124·1**		**116·9**		**86·2**		**100·9**		**116·9**		Percentage of Actual to Expected Deaths.	

Table X.

Family History of Tuberculosis. Combined Experience A_0 to A_{12}.

Endowment Assurances. *Comparison of Actual Deaths with those Expected according to $O^{[M]}$ Table.* *Males.*

Central Age at Entry	Years of Assurance 0		1		2		3		4		5		6		7		8		9		0–9			Central Age at Entry
	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Percentage of Actual to Expected Deaths.	
(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)
20	13·5	14	19·3	20	20·5	15	20·3	13	20·0	28	19·6	13	19·1	12	18·2	5	16·8	10	15·4	13	182·7	143	**78·3**	20
25	33·4	31	48·0	52	52·0	33	51·8	57	50·9	28	50·4	48	49·0	40	47·3	41	44·3	31	40·5	19	467·6	380	**81·3**	25
30	33·2	31	48·5	31	53·9	42	55·8	41	56·8	35	57·0	44	56·5	29	55·4	34	53·4	40	50·1	26	520·6	353	**67·8**	30
35	29·0	33	41·1	37	45·7	33	47·9	35	49·3	42	50·2	18	50·7	36	50·3	37	48·6	36	46·7	39	459·5	346	**75·3**	35
20–35	109·1	109	156·9	140	172·1	123	175·8	146	177·0	133	177·2	123	175·3	117	171·2	117	163·1	117	152·7	97	1630·4	1222	**75·0**	20–35
Percentage	**99·9**		**89·2**		**71·5**		**83·0**		**75·1**		**69·4**		**66·7**		**68·3**		**71·7**		**63·5**		**75·0**			Percentage
40	24·1	23	32·7	21	36·1	23	37·9	17	39·3	27	40·6	29	41·2	25	41·3	21	40·8	18	38·9	24	372·9	228	**61·1**	40
45	17·6	12	22·5	10	24·8	14	26·0	26	26·9	16	28·1	15	28·7	19	28·8	13	28·3	19	26·9	21	258·6	165	**63·8**	45
50	7·1	5	8·4	5	8·8	6	9·2	9	9·6	3	9·9	7	10·4	7	10·4	8	10·1	8	9·5	7	93·4	65	**69·6**	50
40–50	48·8	40	63·6	36	69·7	43	73·1	52	75·8	46	78·6	51	80·3	51	80·5	42	79·2	45	75·3	52	724·9	458	**63·2**	40–50
Percentage	**80·8**		**56·1**		**61·2**		**70·5**		**61·4**		**64·3**		**64·3**		**51·7**		**56·3**		**68·5**		**63·2**			Percentage
Total	157·9	149	220·5	176	241·8	166	248·9	198	252·8	179	255·8	174	255·6	168	251·7	159	242·3	162	228·0	149	2355·3	1680	**71·3**	Total
Percentage	**94·4**		**79·8**		**68·7**		**79·6**		**70·8**		**68·0**		**65·7**		**63·2**		**66·9**		**65·4**		**71·3**		Percentage of Actual to Expected Deaths.	

Tables XI and XII give the summary results for years of assurance 0 to 4 and 5 to 9 for male and female lives respectively.

Table XI.

Family History of Tuberculosis. Combined Experience A_0 *to* A_{12}.

Comparison of Actual Deaths with those Expected according to $O^{[M]}$ *Table.*
First 10 *years of assurance.*

(A). *Whole-Life Assurances.* *Males.*

Ages at Entry	Years of Assurance								
	0-4			5-9			0-9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
-37	66·8	108	**161·7**	100·7	108	**107·2**	167·5	216	**129·0**
38-52	118·5	156	**131·6**	165·0	168	**101·8**	283·5	324	**114·3**
53-62	22·3	19	**85·2**	28·0	27	**96·4**	50 3	46	**91·5**
Total.	207·6	283	**136·3**	293·7	303	**103·2**	501·3	586	**116·9**

(B). *Endowment Assurances.* *Males.*

-37	790·9	651	**82·3**	839·5	571	**68·0**	1630·4	1222	**75·0**
38-52	331·0	217	**65·6**	393·9	241	**61·2**	724·9	458	**63·2**
Total	1121·9	868	**77·4**	1233·4	812	**65·8**	2355·3	1680	**71·3**

Table XII.

Family History of Tuberculosis. Combined Experience A_0 *to* A_{12}.

Comparison of Actual Deaths with those Expected according to $O^{[M]}$ *Table. First* 10 *years of assurance.*

(A). *Whole-Life Assurances.* *Females.*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
–37	10·0	18	**180·0**	15·2	21	**138·2**	25·2	39	**154·8**
38–52	33·5	41	**122·4**	49·7	49	**98·6**	83·2	90	**108·2**
53–62	9·4	8	**85·1**	11·4	10	**87·7**	20·8	18	**86·5**
Total	52·9	67	**126·7**	76·3	80	**104·8**	129·2	147	**113·8**
(B). *Endowment Assurances.*									*Females.*
–37	187·9	141	**75·0**	206·0	122	**59·2**	393·9	263	**66·8**
38–52	106·6	57	**53·5**	142·0	70	**49·3**	248·6	127	**51·1**
Total	294·5	198	**67·2**	348·0	192	**55·2**	642·5	390	**60·7**

The figures relating to the "ultimate" experience, excluding the first ten years of assurance, are given in Table XIII. It is to be observed that in this Table the ages are ages "attained" and not ages at entry.

TABLE XIII.

Family History of Tuberculosis. Combined Experience A_0 *to* A_{12}.

Comparison of Actual Deaths with those Expected according to $O^{[M]}$ *Table.*

Ultimate Experience, excluding first 10 *years of assurance.*

(A). *Whole-life Assurances.* *Males.*

Central Age attained (1)	Expected Deaths (2)		Actual Deaths (3)		Percentage (4)
30	1·3		1		
35	11·7	13·0	15	16	**123·1**
40	39·3		38		
45	84·0	123·3	87	125	**101·4**
50	125·9		126		
55	161·3	287·2	137	263	**91·6**
60	173·1		199		
65	127·2	300·3	124	323	**107·6**
70	72·0		70		
75	34·7	106·7	30	100	**93·7**
80	14·4		17		**118·1**

(B). *Endowment Assurances.* *Males.*

30	24·9		15		
35	122·8	147·7	82	97	**65·7**
40	206·1		119		
45	243·5	449·6	155	274	**60·9**
50	230·7		148		
55	172·6	403·3	128	276	**68·4**
60	90·8		82		
65	14·1	104·9	11	93	**88·7**

Caution necessary in using Percentages of Totals.

It is hoped that the arrangement of the results in the form of percentages of a standard Table may enable the facts to be readily grasped; but it is necessary to point out that the percentages deduced from the totals for all ages at entry must be used with caution in making comparisons between different sections of the data.

This caution is required because the varying age constitution of the groups is quite lost sight of in these percentages of totals.

The point is well illustrated by reference to the percentages

given in Table XI for years of assurance 0 to 4. Under whole-life assurances the percentage in total is 136·3, while that for endowment assurances is 77·4. Taken by themselves, these figures would appear to show a difference of 58·9 per-cent in favour of the endowment assurances. If, however, the whole-life experience had not extended beyond age 52 at entry the percentage for that Table would have been increased to 142·5, thus showing the larger difference of 65·1 per-cent between the classes of assurance. Even this statement does not fully express the difference between the rates in the two particular sections, for the average age at entry in the whole-life experience was higher than that under endowment assurances, and a redistribution of the whole-life experience according to age at entry, in the same proportion as the exposed to risk under the endowment assurances, would have led to an even greater divergence in the percentages—as we proceed to show.

The exposed to risk which formed the basis of Table XI for years of assurance 0 to 4 are set out in Table XIV.

TABLE XIV.

Exposed to Risk for Years of Assurance 0 *to* 4.

Male Lives. *Group* A_0 *to* A_{12}.

Ages at Entry (1)	Whole-Life		Endowment Assurances	
	Exposed to Risk (2)	Percentage on Total Exposures (3)	Exposed to Risk (4)	Percentage on Total Exposures (5)
–37	12,024	**47·9**	152,216	**79·0**
38–52	13,094	**52·1**	40,518	**21·0**
Total	25,118	**100·0**	192,734	**100·0**

Applying the percentages shown in column 5 of Table XIV to redistribute the expected and actual deaths in columns 2 and 3 of Table XI (A), the percentage of actual to expected deaths for ages at entry below 53 is 152·5. This, then, would have been the percentage in the whole-life class if the age-distribution had been identical with that under endowment assurances, and the difference between the classes, instead of 58·9 as it at present stands, would have been no less than 75·1 per-cent.

Owing to the variations in age distribution this warning against the use of percentages of totals is also required in a modified degree in making comparisons between the sub-groups for the same class of assurance.

The percentages of totals are useful for comparing the figures within the group to which the totals refer, but cannot be relied upon for other purposes, and comparisons between the different classes of risk should be made, as far as possible, by means of the percentages for corresponding age-groups.

Difference in Mortality between Whole-Life and Endowment Assurances.

The first point that attracts attention is the great difference between the mortality in the two classes of assurance. From Table XI it will be seen that in years of assurance 0 to 4 the mortality in the whole-life class is, approximately, double that in the endowment assurance class, and even for years 5 to 9 there is a difference of about 40 in the percentages, whilst much greater differences are shown in Table XII. As will be seen later on, this feature is not peculiar to the Combined Table, but appears in every sub-group, and is throughout more marked amongst female than male lives. Nor is it confined only to the first ten years of assurance, as it is just as clearly a feature of the ultimate experience given in Table XIII. Again, it will be noted that the whole-life male experience follows the $O^{[M]}$ mortality fairly closely after the first five years of assurance, whilst the endowment assurances for ages at entry under 38 follow that of the $O^{[EM]}$. Above that age the endowment assurances show more favourable results, and in the "Ultimate" experience the mortality is lighter than that of the $O^{[EM]}$. That endowment assurances should show such light rates after the first five years is somewhat unexpected, and we suggest, as an explanation, that the selection exercised by the assured is a most potent factor and practically of equal importance to the medical selection. No doubt, had it been possible to distinguish between the various terms of years for which the endowment assurances were effected, the mortality would have shown results corresponding to such terms. One thing seems obvious: that in the assessment of risks there should be a differentiation in practice as between whole-life and endowment assurances.

Male and Female Mortality compared.

Another feature of these Tables is the lighter rate of mortality experienced by female lives than by male lives. This feature is brought out clearly by

comparing Table XI with Table XII, and is persistent for each group of entry-ages and for each section of the Tables for the first ten years of assurance, with the single exception of ages at entry below 38 under whole-life assurances. The exception is noteworthy, as the excess mortality is considerable, and coincides with the results of previous experiences under whole-life assurances on female lives. It may possibly point to the fact that under endowment assurances the spinsters are in greater proportion than the married women.

High Mortality-Rate in Early Years of Assurance.

Returning to the high rate of mortality during the first five years of assurance, it will be seen that whilst the endowment assurance rates are but little in excess of $O^{[EM]}$, the whole-life are considerably in excess of $O^{[M]}$. From Tables IX and X it will be seen that this excess in both whole-life and endowment assurances is at its maximum in year of assurance 0, and that it decreases fairly rapidly with the duration. In regard to the year of assurance 0, it is to be remarked that the $O^{[EM]}$ experience also shows a relatively heavy rate of mortality at this period as compared with $O^{[M]}$. This raises a doubt as to whether, from some unexplained cause, the $O^{[M]}$ may not give too small a value for $q_{[x]+0}$, and, consequently, whether it is a suitable standard at this point. After making all allowances for this possibility, however, it would still appear that the mortality experienced in the early years of assurance was heavy. The excess is greatest for the younger ages at entry. Combining these facts, we may say that the effect of a definite family history of tuberculosis shows itself mainly in the younger ages at entry and the early years of assurance.

Tuberculosis. Sectional Experiences.

Passing from the consideration of Group A as a whole, we consider next the three main sections of which it is composed. These are (α) Lineals, (β), Lineals plus Collaterals and (γ) Collaterals. The same general arrangement of the Tables has been adopted as for the combined results, except that owing to paucity of data, the detailed facts for each of the first ten years of assurance are shown only for endowment assurances on male lives.

It may be well to point out here that the terms "lineal" and "collateral" are used throughout this Paper in the special and restricted sense indicated in the Table of Classification.

TABLE XV.

(a) *Family History of Tuberculosis in Lineals.*

Endowment Assurances. *Comparison of Actual Deaths with those Expected according to* O^{M} *Table.* *Males.*

Central Age at Entry	Years of Assurance																				Central Age at Entry
	0		1		2		3		4		5		6		7		8		9		0–9			
	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Percentage of Actual to Expected Deaths	
(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)
20	6·9	7	9·7	12	10·3	8	10·1	5	9·9	12	9·6	5	9·2	6	8·7	2	7·9	7	7·1	7	89·4	71	**79·4**	20
25	15·0	14	21·0	24	22·6	19	22·2	23	21·7	11	21·3	26	20·5	14	19·8	13	18·5	14	16·6	10	199·2	168	**84·3**	25
30	12·7	15	18·2	10	19·9	18	20·4	18	20·5	15	20·2	14	19·5	9	18·8	8	17·9	14	16·5	11	184·6	132	**71·5**	30
35	8·9	6	12·2	11	13·3	7	13·7	6	13·9	4	14·0	4	13·7	10	13·3	7	12·7	10	12·0	12	127·7	77	**60·3**	35
20–35	43·5	42	61·1	57	66·1	52	66·4	52	66·0	42	65·1	49	62·9	39	60·6	30	57·0	45	52·2	40	600·9	448		20–35
Per-centage	**96·6**		**93·3**		**78·7**		**78·3**		**63·6**		**75·3**		**62·0**		**49·5**		**78·9**		**76·6**		**74·6**		**74·6**	Per-centage
40	6·0	7	8·0	6	8·6	9	8·7	4	8·8	7	9·0	10	8·9	1	8·8	8	8·4	5	7·6	4	82·8	61	**73·7**	40
45	3·8	2	4·7	1	5·1	5	5·2	4	5·3	2	5·3	3	5·4	4	5·2	1	5·1	1	4·7	7	49·8	30	**60·2**	45
50	1·1	1	1·3	1	1·4	...	1·5	...	1·6	...	1·6	...	1·6	1	1·5	...	1·4	1	1·4	...	14·4	4	**27·8**	50
40–50	10·9	10	14·0	8	15·1	14	15·4	8	15·7	9	15·9	13	15·9	6	15·5	9	14·9	7	13·7	11	147·0	95		40–50
Per-centage	**91·7**		**57·1**		**92·7**		**51·9**		**57·3**		**81·8**		**37·7**		**58·1**		**47·0**		**80·3**		**64·6**		**64·6**	Per-centage
Total	54·4	52	75·1	65	81·2	66	81·8	60	81·7	51	81·0	62	78·8	45	76·1	39	71·9	52	65·9	51	747·9	543	**72·6**	Total
Per-centage	**95·6**		**86·6**		**81·3**		**73·3**		**62·4**		**76·5**		**57·1**		**51·2**		**72·3**		**77·4**		**72·6**		Percentage of Actual to Expected Deaths.	

TABLE XVI.

(β) *Family History of Tuberculosis in Lineals plus Collaterals.*

Endowment Assurances. *Comparison of Actual Deaths with those Expected according to* O[M] *Table.* *Males.*

Central Age at Entry	Years of Assurance																						Central Age at Entry
	0		1		2		3		4		5		6		7		8		9		0–9			
	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Percentage of Actual to Expected Deaths	
(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)
20	·9	2	1·3	1	1·4	3	1·5	1	1·5	1	1·5	1	1·6	1	1·6	1	1·6	...	1·5	2	14·4	13	**90·3**	20
25	3·4	3	5·1	6	5·8	2	5·9	9	5·9	4	6·0	3	6·1	3	6·1	5	5·9	5	5·6	2	55·8	42	**75·3**	25
30	4·2	3	6·4	7	7·3	3	7·7	5	7·9	4	8·2	7	8·4	3	8·4	3	8·3	3	7·9	2	74·7	40	**53·5**	30
35	4·2	4	6·2	8	7·0	5	7·6	5	8·0	2	8·3	2	8·7	9	8·8	3	8·7	4	8·6	3	76·1	45	**59·1**	35
20–35	12·7	12	19·0	22	21·5	13	22·7	20	23·3	11	24·0	13	24·8	16	24·9	12	24·5	12	23·6	9	221·0	140	**63·3**	20–35
Per-centage	**94·5**		**115·8**		**60·5**		**88·1**		**47·2**		**54·2**		**64·5**		**48·2**		**49·0**		**38·1**		**63·3**			Per-centage
40	3·8	1	5·3	2	6·0	4	6·6	...	7·0	3	7·2	6	7·4	5	7·6	3	7·8	...	7·7	5	66·4	29	**43·7**	40
45	2·8	...	3·7	2	4·3	1	4·6	4	4·8	1	5·1	1	5·5	2	5·5	2	5·5	6	5·2	5	47·0	24	**51·1**	45
50	1·4	2	1·7	...	1·8	3	1·8	3	1·9	...	2·1	1	2·2	...	2·3	1	2·3	1	2·3	2	19·8	13	**65·7**	50
40–50	8·0	3	10·7	4	12·1	8	13·0	7	13·7	4	14·4	8	15·1	7	15·4	6	15·6	7	15·2	12	133·2	66	**49·5**	40–50
Per-centage	**37·5**		**37·4**		**66·1**		**53·8**		**29·2**		**55·6**		**46·4**		**39·0**		**44·9**		**78·9**		**49·5**			Per-centage
Total	20·7	15	29·7	26	33·6	21	35·7	27	37·0	15	38·4	21	39·9	23	40·3	18	40·1	19	38·8	21	354·2	206	**58·2**	Total
Per-centage	**72·5**		**87·5**		**62·5**		**75·6**		**40·5**		**54·7**		**57·6**		**44·7**		**47·4**		**54·1**		**58·2**		Percentage of Actual to Expected Deaths.	

TABLE XVII.

(γ) *Family History of Tuberculosis in Collaterals.*

Endowment Assurances. *Comparison of Actual Deaths with those Expected according to* $O^{[M]}$ *Table.* *Males.*

Central Age at Entry	Year of Assurance																				Central Age at Entry
	0		1		2		3		4		5		6		7		8		9		0–9		
	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Expected Deaths	Actual Deaths	Percentage of Actual to Expected Deaths	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(2)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
20	5·4	5	7·8	6	8·3	4	8·3	7	8·1	14	8·0	7	7·9	5	7·5	2	6·9	3	6·3	4	74·5	57	**76·5**	20
25	14·7	14	21·4	22	23·1	11	23·2	24	22·8	13	22·5	19	21·9	23	20·9	23	19·3	12	17·7	7	207·5	168	**81·0**	25
30	16·2	12	23·7	14	26·4	21	27·5	18	28·1	16	28·3	23	28·4	17	28·0	23	26·9	23	25·4	13	258·9	180	**69·5**	30
35	15·8	23	22·6	18	25·2	21	26·4	24	27·1	36	27·7	12	28·1	17	28·0	27	27·0	22	25·9	24	253·8	224	**88·3**	35
20–35	52·1	54	75·5	60	83·0	57	85·4	73	86·1	79	86·5	61	86·3	62	84·4	75	80·1	60	75·3	48	794·7	629		20–35
Per-centage	**103·6**		**79·5**		**68·7**		**85·5**		**91·8**		**70·5**		**71·8**		**88·9**		**74·9**		**63·7**		**79·1**		**79·1**	Per-centage
40	14·2	15	19·3	13	21·4	10	22·5	13	23·4	17	24·4	13	24·9	19	24·9	10	24·6	13	23·5	15	223·1	138	**61·9**	40
45	11·0	10	14·0	7	15·4	8	16·2	18	16·8	13	17·6	11	17·8	13	18·0	10	17·7	12	16·9	9	161·4	111	**68·8**	45
50	4·6	2	5·4	4	5·6	3	5·8	6	6·0	3	6·2	6	6·5	6	6·6	7	6·4	6	5·8	5	58·9	48	**81·5**	50
40–50	29·8	27	38·7	24	42·4	21	44·5	37	46·2	33	48·2	30	49·2	38	49·5	27	48·7	31	46·2	29	443·4	297		40–50
Per-centage	**90·6**		**62·0**		**49·5**		**83·1**		**71·4**		**62·2**		**77·2**		**54·5**		**63·7**		**62·8**		**67·0**		**67·0**	Per-centage
Total	81·9	81	114·2	84	125·4	78	129·9	110	132·3	112	134·7	91	135·5	100	133·9	102	128·8	91	121·5	77	1238·1	926	**74·8**	Total
Per-centage	**98·9**		**73·6**		**62·2**		**84·7**		**84·7**		**67·6**		**73·8**		**76·2**		**70·7**		**63·4**		**74·8**		Percentage of Actual to Expected Deaths	

In the five succeeding Tables the policy-years have been grouped in the manner already described; Tables XVIII and XIX show the results for whole-life assurances, and Tables XX and XXI for endowment assurances, respectively, on male lives, whilst Table XXII deals with endowment assurances on female lives.

Table XVIII.

Family History of Tuberculosis. *Sectional Tables.*

Comparison of Actual Deaths with those Expected according to O[M] *Table.*

First 10 *years of Assurance.*

Whole-Life Assurances *Males.*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
				(α) *Lineals.*					
–37	26·6	47	**176·7**	37·4	46	**123·0**	64·0	93	**145·3**
38–52	27·4	37	**135·0**	31·2	39	**125·0**	58·6	76	**129·7**
53–62	3·7	3	**81·1**	4·3	3	**69·8**	8·0	6	**75·0**
Total	57·7	87	**150·8**	72·9	88	**120·7**	130·6	175	**134·0**
				(β) *Lineals plus Collaterals.*					
–37	9·5	13	**136·8**	15·4	18	**116·9**	24·9	31	**124·5**
38–52	21·8	37	**169·7**	33·1	30	**90·6**	54·9	67	**122·0**
53–62	5·0	3	**60·0**	6·7	9	**134·3**	11·7	12	**102·6**
Total	36·3	53	**146·0**	55·2	57	**103·3**	91·5	110	**120·2**
				(γ) *Collaterals.*					
–37	29·4	46	**156·5**	47·1	44	**93·4**	76·5	90	**117·6**
38–52	68·6	82	**119·5**	100·0	98	**98·0**	168·6	180	**106·8**
53–62	13·2	13	**98·5**	15·8	12	**75·9**	29·0	25	**86·2**
Total	111·2	141	**126·8**	162·9	154	**94·5**	274·1	295	**107·6**

Table XIX.

Family History of Tuberculosis. Sectional Tables.

Comparison of Actual Deaths with those Expected according to $O^{[M]}$ *Table.*

Ultimate Experience, excluding first 10 *years of Assurance.*

Whole-life Assurances. *Males.*

Central Age attained (1)	Expected Deaths (2)		Actual Deaths (3)		Percentage (4)
		(α) *Lineals.*			
40	16·2		14		
45	29·7	45·9	33	47	**102·4**
50	36·2		37		
55	34·9	71·1	29	66	**92·8**
60	30·4		37		
65	18·9	49·3	27	64	**129·8**
70	9·4		9		
75	5·1	14·5	5	14	**96·6**
		(β) *Lineals plus Collaterals.*			
40	5·2		7		
45	12·0	17·2	10	17	**98·8**
50	17·7		25		
55	24·9	42·6	17	42	**98·6**
60	30·7		40		
65	22·8	53·5	19	59	**110·3**
70	11·8		17		
75	4·0	15·8	2	19	**120·3**
		(γ) *Collaterals.*			
40	17·4		17		
45	41·7	59·1	44	61	**103·2**
50	71·3		64		
55	101·0	172·3	91	155	**90·0**
60	111·1		122		
65	84·6	195·7	77	199	**101·7**
70	50·5		44		
75	25·4	75·9	23	67	**88·3**

Tuberculosis in Lineals and Collaterals compared.

It will be seen from Table XVIII that in the whole-life experience, up to age 52, the percentages of actual deaths to those expected amongst lineals are in every instance greater than the corresponding percentages amongst collaterals. In the "ultimate" experience given in

Table XIX, the differences, though still in the same direction, are not quite so marked.

Taken by itself this would seem to indicate that a history of tuberculosis in a parent should be viewed more seriously than a similar history in brothers or sisters. But upon turning to the corresponding figures for endowment assurances in Tables XX and XXI the results are reversed, with the exception of attained ages below 48 in the Ultimate Table.

Table XX.

Family History of Tuberculosis. *Sectional Tables.*

Comparison of Actual Deaths with those Expected according to O[M] *Table.*

First 10 *years of Assurance.*

Endowment Assurances. *Males.*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
				(α) *Lineals.*					
–37	303·1	245	**80·8**	297·8	203	**68·2**	600·9	448	**74·6**
38–52	71·1	49	**68·9**	75·9	46	**60·6**	147·0	95	**64·6**
Total	374·2	294	**78·6**	373·7	249	**66·6**	747·9	543	**72·6**
				(β) *Lineals plus Collaterals.*					
–37	99·2	78	**78·6**	121·8	62	**50·9**	221·0	140	**63·3**
38–52	57·5	26	**45·2**	75·7	40	**52·8**	133·2	66	**49·5**
Total	156·7	104	**66·4**	197·5	102	**51·6**	354·2	206	**58·2**
				(γ) *Collaterals.*					
–37	382·1	323	**84·5**	412·6	306	**74·2**	794·7	629	**79·1**
38–52	201·6	142	**70·4**	241·8	155	**64·1**	443·4	297	**67·0**
Total	583·7	465	**79·7**	654·4	461	**70·4**	1238·1	926	**74·8**

Table XXI.

Family History of Tuberculosis. Sectional Tables.

Comparison of Actual Deaths with those Expected according to O$^{[M]}$ *Table.*

Ultimate Experience, excluding first 10 *years of Assurance.*

Endowment Assurances. *Males.*

Central Age attained (1)	Expected Deaths (2)		Actual Deaths (3)		Percentage (4)
		(α) *Lineals.*			
30	11·1	61·1	8	44	**72·0**
35	50·0		36		
40	71·7	137·4	38	85	**61·9**
45	65·7		47		
50	49·1	78·3	39	55	**70·2**
55	29·2		16		
60	13·0	15·2	9	9	**59·2**
65	2·2		...		
		(β) *Lineals plus Collaterals.*			
30	2·4	19·0	2	12	**63·2**
35	16·6		10		
40	31·0	71·5	16	52	**72·7**
45	40·5		36		
50	43·1	75·9	26	46	**60·6**
55	32·8		20		
60	19·3	21·5	20	23	**107·0**
65	2·2		3		
		(γ) *Collaterals.*			
30	10·4	63·9	5	40	**62·6**
35	53·5		35		
40	100·8	236·5	65	137	**57·9**
45	135·7		72		
50	137·7	247·9	83	175	**70·6**
55	110·2		92		
60	57·9	67·5	52	60	**88·9**
65	9·6		8		

Table XXII.

Family History of Tuberculosis. Sectional Tables.

Comparison of Actual Deaths with those Expected according to $O^{[M]}$ *Table.*

First 10 *years of Assurance.*

Endowment Assurances. *Females.*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
				(α) *Lineals.*					
–37	76·6	53	**69·2**	78·4	42	**53·6**	155·0	95	**61·3**
38–52	26·0	12	**46·2**	31·5	13	**41·3**	57·5	25	**43·5**
Total	102·6	65	**63·4**	109·9	55	**50·0**	212·5	120	**56·5**
				(β) *Lineals plus Collaterals.*					
–37	23·6	20	**84·7**	29·2	18	**61·6**	52·8	38	**72·0**
38–52	19·2	8	**41·7**	26·4	16	**60·6**	45·6	24	**52·6**
Total	42·8	28	**65·4**	55·6	34	**61·2**	98·4	62	**63·0**
				(γ) *Collaterals.*					
–37	85·0	68	**80·0**	95·2	58	**60·9**	180·2	126	**69·9**
38–52	60·9	36	**59·1**	83·5	41	**49·1**	144·4	77	**53·3**
Total	145·9	104	**71·3**	178·7	99	**55·4**	324·6	203	**62·5**

It should also be noted that the figures in Table XXII, deduced from endowment assurances on female lives, support in every particular the results shown in Table XX as between lineal and collateral tuberculous family history for male lives under endowment assurances. The contrary results shown as between whole-life and endowment assurances on male lives prevent any dogmatic assertion on the basis of the figures alone as to the relative weight to be attached to tuberculous history in lineals and collaterals respectively. In view, however, of the very much larger numbers exposed to risk in the endowment assurance as compared with the whole-life experience and the support accorded to the former by the experience on female lives under endowment assurances, we have no hesitation in expressing it as our opinion that at least as much attention—if not more—must be given to a history of tuberculosis amongst brothers and sisters as amongst parents.

Lineals plus Collaterals.

In view of the fact that for a life to be included in Section β, two at least of the assured's family must have died from tuberculosis, a heavier rate of mortality might reasonably have been expected than under either of the other two sections.

It will be seen, however, that in the whole-life experience on male lives the percentages shown in Table XVIII for this section lie, on the whole, practically midway between the corresponding figures in the other two sections. When we come to endowment assurances on male lives (Table XX), not only do we find light rates of mortality, but we have the unexpected result that for each group of ages at entry and for all durations the rates are considerably below those in either of the other sections.

It is true that the percentages are derived from a much smaller number of exposures than in either of the other two sections, and this may possibly account for the apparent anomaly; but, no doubt, other causes were also in operation. It is probable, for instance, that in the medical selection of these lives special care was taken to ensure that in all respects, other than the defects in the family history—such as personal condition, occupation, &c.—the applicants were unimpeachably first-class lives. Or, it may be, that the assured, knowing the family weakness, have taken great personal care not to incur risks likely to injure their health. It is just possible, also, that there may be some truth in the modified form of the "immunisation" theory put forward by some medical writers, namely, that a family

taint of tuberculosis may have worked itself out in other members of the family, and have left the surviving members actually less liable to the ravages of this disease than the average man. In regard to this, moreover, it should be borne in mind that the family history dealt with in this experience is the history as it stands at the date of application for assurance—a period at which, in a large number of cases, it is not by any means complete. In this particular section it is more complete than in the others.

Another likely cause may have been the terms upon which lives were accepted under this section. They were only accepted subject to a surcharge in the nature of a contingent debt. This debt formed a heavy initial deduction from the sum assured rapidly diminishing with the duration of the policy. In the circumstances, it is arguable that only lives who considered themselves to have a reasonable expectation of surviving the contingent debt period would take up the policies.

The figures given in Table XXII for female lives under endowment assurances do not support the results shown in Tables XX and XXI in regard to the light rate of Section β. With a single exception the percentages of actual to expected deaths are higher under Section β than under either Section α or γ; there is, however, practically no difference between the percentages under Sections β and γ and this would tend to show that as with male so also with female risks, tuberculosis in collaterals should be given at least equal weight to that in lineals.

Analysis in Sub-groups.

We now pass to a brief consideration of the individual sub-groups. The only section of the data that permitted of analysis in such detail was that relating to endowment assurances on male lives, and Sub-group A_0 was omitted owing to paucity of data. Even then it would have been useless to set out the results for each year of assurance. The results for grouped periods are set out in Tables XXIII, XXIV, and XXV in a similar manner to those given for the Combined and Sectional Tables.

Table XXIII.

Family History of Tuberculosis. Sub-groups A_1 *to* A_4.
Comparison of Actual Deaths with those Expected according to $O^{[M]}$ *Table.*
First 10 *years of Assurance.*

Endowment Assurances. (a) *Lineals.* *Males*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	4)	(5)	(6)	(7)	(8)	(9)	(10)
				A_1—*Father only.*					
–37	143·9	124	**86·2**	137·9	101	**73·2**	281·8	225	**79·8**
38–52	31·4	25	**79·6**	32·0	24	**75·0**	63·4	49	**77·3**
Total	175·3	149	**85·0**	169·9	125	**73·6**	345·2	274	**79·4**
				A_2—*Mother only (consumption).*					
–37	98·6	87	**88·2**	96·2	63	**65·5**	194·8	150	**77·0**
38–52	22·9	16	**69·9**	23·8	11	**46·2**	46·7	27	**57·8**
Total	121·5	103	**84·8**	120·0	74	**61·7**	241·5	177	**73·3**
				A_3—*Mother only (childbirth).*					
–37	33·2	25	**75·3**	30·9	24	**77·7**	64·1	49	**76·4**
38–52	8·7	8	**92·0**	9·9	6	**60·6**	18·6	14	**75·3**
Total	41·9	33	**78·8**	40·8	30	**73·5**	82·7	63	**76·2**
				A_4—*Father and Mother (consumption).*					
–37	27·0	9	**33·3**	32·3	15	**46·4**	59·3	24	**40·5**
38–52	7·7	2	**26·0**	10·3	3	**29·1**	18·0	5	**27·8**
Total	34·7	11	**31·7**	42·6	18	**42·3**	77·3	29	**37·5**

Table XXIV.

Family History of Tuberculosis. Sub-groups A_5 *to* A_9.
Comparison of Actual Deaths with those Expected according to $O^{[M]}$ *Table.*
First 10 *years of Assurance.*

Endowment Assurances. *Males.*

(β) Lineals plus Collaterals.

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A_5—*Father plus Brother or Sister (consumption).*									
–37	38·1	29	**76·1**	46·5	31	**66·7**	84·6	60	**70·9**
38–52	21·3	15	**70·4**	26·6	19	**71·4**	47·9	34	**71·0**
Total	59·4	44	**74·1**	73·1	50	**68·4**	132·5	94	**70·9**
A_6—*Mother plus Brother or Sister (consumption).*									
–37	37·3	29	**77·7**	46·2	18	**39·0**	83·5	47	**56·3**
38–52	20·2	8	**39·6**	27·9	7	**25·1**	48·1	15	**31·2**
Total	57·5	37	**64·3**	74·1	25	**33·7**	131·6	62	**47·1**
A_7—*Mother (childbirth) plus Sister (childbirth).*									
Total	...	...	...	...	...	...	9·0	6	**66·7**
A_8—*Mother (childbirth) plus Brother or Sister (consumption).*									
–37	15·7	15	**95·5**	19·1	9	**47·1**	34·8	24	**69·0**
38–52	9·6	2	**20·8**	12·7	5	**39·4**	22·3	7	**31·4**
Total	25·3	17	**67·2**	31·8	14	**44·0**	57·1	31	**54·3**
A_9—*Father and Mother plus Brother or Sister (consumption).*									
–37	5·0	3	**60·0**	7·4	3	**40·5**	12·4	6	**48·4**
38–52	4·0	...	...	6·2	5	**80·6**	10·2	5	**49·0**
Total	9·0	3	**33·3**	13·6	8	**58·8**	22·6	11	**48·7**

Table XXV.

Family History of Tuberculosis. Sub-groups A_{10} *to* A_{12}.
Comparison of Actual Deaths with those Expected according to $O^{[M]}$ *Table.*
First 10 *years of Assurance.*
Endowment Assurances. (γ) *Collaterals.* *Males.*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
				A_{10}—*Sister (childbirth).*					
–37	7·5	16	**213·3**	7·2	13	**180·6**	14·7	29	**197·3**
38–52	4·4	8	**181·8**	5·8	6	**103·4**	10·2	14	**137·3**
Total	11·9	24	**201·7**	13·0	19	**146·2**	24·9	43	**172·7**
				A_{11}—*One Brother or Sister (consumption).*					
–37	282·5	247	**87·4**	288·4	211	**73·2**	570·9	458	**80·2**
38–52	116·4	89	**76·5**	131·2	97	**73·9**	247·6	186	**75·1**
Total	398·9	336	**84·2**	419·6	308	**73·4**	818·5	644	**78·7**
				A_{12}—*Two or more Brothers or Sisters (consumption).*					
–37	92·5	60	**64·9**	116·9	82	**70·1**	209·4	142	**67·8**
38–52	80·6	45	**55·8**	105·3	52	**49·4**	185·9	97	**52·2**
Total	173·1	105	**60·7**	222·2	134	**60·3**	395·3	239	**60·5**

To enable these sub-groups to be the more easily compared, Table XXVI is added, giving the percentages only. Sub-group A_7 is omitted as the facts are too small for inclusion.

Table XXVI.

Family History of Tuberculosis. Sub-groups A_1 *to* A_{12}.

Comparison for each Sub-group of the Percentages of Actual Deaths to those Expected by $O^{[M]}$ *Table.*

First 10 years of Assurance.

Endowment Assurances. *Males.*

Sub-Groups	Ages at Entry under 37		Ages at Entry 38–52	
	Years of Assurance		Years of Assurance	
	0–4	5–9	0–4	5–9
(1)	(2)	(3)	(4)	(5)
A_1	86·2	73·2	79·6	75·0
A_2	88·2	65·5	69·9	46·2
A_3	75·3	77·7	92·0	60·6
A_4	33·3	46·4	26·0	29·1
A_5	76·1	66·7	70·4	71·4
A_6	77·7	39·0	39·6	25·1
A_8	95·5	47·1	20·8	39·4
A_9	60·0	40·5	...	80·3
A_{10}	213·3	180·6	181·8	103·4
A_{11}	87·4	73·2	76·5	73·9
A_{12}	64·9	70·1	55·8	49·4

Low Mortality where Family History of two Tuberculous Deaths.

The first fact that strikes the attention is that in the sub-groups A_4, A_9, and A_{12}, in all of which there is a family history of at least two deaths from tuberculosis, the mortality is exceptionally light. The data in A_4 and A_9 are small, but, on the other hand, the percentages in all three sub-groups are fairly consistent with one another.

The most striking difference is shown in the comparison of sub-groups A_{11} and A_{12}, in both of which the data are substantial. It will be seen that the mortality is throughout and in a marked degree in favour of Sub-group A_{12}. That is to say,

the mortality shown is considerably better when two or more brothers or sisters have died from tuberculosis than when only one such relative has died from that disease. Probably causes similar to those suggested in connection with the mortality of Section (β) (Lineals plus Collaterals) are also in operation here.

High Mortality where Family History of death in Childbirth.

Another striking feature is the heavy rate experienced in sub-group A_{10}, where the family history is that a sister died in childbirth. This heavy rate, exceptionally high at the younger ages at entry, is observable throughout the Table. It will be noticed that in sub-group A_3, where the mother died in childbirth, the mortality is also comparatively heavy. The smallness of the data warns us against drawing too hasty conclusions; perhaps this may be a case of the inheritance of a poor constitution with consequent inability to resist infection or to recover from serious illness. However this may be, it seems clear that the death of either the mother or sister in childbirth must be given special attention in estimating assurance risks.

Comparing A_1 with A_2 it will be noticed that the rates are higher in the former than in the latter. This, as far as it goes, would tend to show that tuberculosis in a father is of more importance than in a mother. To some extent this tendency seems to be supported by the figures in A_5, when compared with those in A_6 and A_8, in which sub-groups the mother died from tuberculosis or in childbirth.

Sub-group A_{11}—brother or sister died from tuberculosis—is entitled to considerable weight in view of the fact that it records the experience of a large body of data. Comparing the percentages with those for Sub-groups A_1 and A_2 it will be seen that there is very little difference in the first five years of assurance, but in years of assurance 5 to 9 the mortality is substantially higher than it is in sub-group A_2. Thus where there is only one tuberculous death in the family it does not appear that there is any material difference whether that death is of a lineal or of a collateral relation.

Definite Tuberculous Family History—General Summary.

Throughout the whole of the comparative Tables on male lives it will be noticed that the excess mortality is greatest in the youngest group of ages at entry, and that it is practically confined to the first 10 years of assurance. This feature is unmistakeable, and it is also shown in a marked degree in the Tables for female lives.

When each experience is compared with the normal mortality for the corresponding class of assurance it will be seen that there in no trace of excess mortality in the endowment assurances above age 37 at entry, and in the whole-life assurances after about age 50 at entry.

Furthermore, the *degree* of tuberculous family history is of much less importance than the age at entry, and may, in fact, be said to have no practical value for assurance purposes over age 35 at entry.

Family History of Non-Tuberculous Pulmonary Disease and of Presumptive Tuberculous Taint.

Hitherto no account has been taken of the sub-groups numbered A_{13}, A_{14}, and A_{15}. The figures for A_{13}, and for the combined groups A_{14} and A_{15}, together with a further group designated A+E, are set out in Tables XXVII, XXVIII, and XXIX. This latter group was composed of such cases as combined a tuberculous family history with some personal defect in the life; these defects were, mainly, indifferent health or poor physique, and include weights markedly below the standard. Groups A_{14} and A_{15} have been combined, as the family history in both is of an indefinite character.

It will be seen that the mortality throughout these sub-groups is heavy, particularly so in the male whole-life group which combines a tuberculous family history with some personal defect. In none of these groups were the data sufficient to warrant tabulation in "ultimate" form.

Table XXVII.

Comparison of Actual Deaths with those Expected according to $O^{[M]}$ *Table.*
First 10 *years of Assurance.*

Whole-Life Assurances. *Males.*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A_{13}—*Family History of Non-Tuberculous Pulmonary Disease.*									
–37	7·6	7	**92·1**	8·2	10	**122·0**	15·8	17	**107·6**
38–52	13·1	23	**175·6**	15·0	11	**73·3**	28·1	34	**121·0**
53–62	1·4	1	**71·4**	1·4	2	**142·9**	2·8	3	**107·1**
Total	22·1	31	**140·3**	24·6	23	**93·5**	46·7	54	**115·6**
A_{14} *and* A_{15}—*Unknown or Obscure Family History.*									
–37	16·4	26	**158·5**	20·1	27	**134·3**	36·5	53	**145·2**
38–52	36·0	68	**188·9**	44·2	43	**97·3**	80·2	111	**138·4**
53–62	7·6	6	**78·9**	8·2	13	**158·5**	15·8	19	**120·3**
Total	60·0	100	**166·7**	72·5	83	**114·5**	132·5	183	**138·1**
A+E—*Tuberculous Family History plus Personal Defect*									
–37	7·2	15	**208·3**	11·0	18	**163·6**	18·2	33	**181·3**
38–52	11·6	12	**103·4**	17·8	34	**191·0**	29·4	46	**156·5**
53–62	3·7	10	**270·3**	4·8	12	**250·0**	8·5	22	**258·8**
Total	22·5	37	**164·4**	33·6	64	**190·5**	56·1	101	**180·0**

Table XXVIII

Comparison of Actual Deaths with those Expected according to O[M] *Table.*

First 10 *years of Assurance.*

Endowment Assurances. *Males.*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A_{13}—*Family History of Non-Tuberculous Pulmonary Disease.*									
–37	31·5	35	**111·1**	26·2	20	**76·3**	57·7	55	**95·3**
38–52	10·7	16	**149·5**	10·8	13	**120·4**	21·5	29	**134·9**
Total	42·2	51	**120·9**	37·0	33	**89·2**	79·2	84	**106·1**
A_{14} *and* A_{15}—*Unknown or Obscure Family History.*									
–37	98·4	115	**116·9**	96·9	109	**112·5**	195·3	224	**114·7**
38–52	50·3	57	**113·3**	56·3	57	**101·2**	106·6	114	**106·9**
Total	148·7	172	**115·7**	153·2	166	**108·4**	301·9	338	**112·0**
A + E—*Tuberculous Family History plus Personal Defect.*									
–37	56·8	52	**91·5**	74·0	68	**91·9**	130·8	120	**91·7**
38–52	26·9	29	**107·8**	36·0	37	**102·8**	62·9	66	**104·9**
Total	83·7	81	**96·8**	110·0	105	**95·5**	193·7	186	**96·0**

Table XXIX.

Comparison of Actual Deaths with those Expected according to $O^{[M]}$ *Table.*

First 10 *years of Assurance.*

Endowment Assurances. *Females.*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A_{13}—*Family History of Non-Tuberculous Pulmonary Disease.*									
–37	7·5	12	**160·0**	6·5	5	**76·9**	14·0	17	**121·4**
38–52	3·5	6	**171·4**	3·4	5	**147·1**	6·9	11	**159·4**
Total	11·0	18	**163·6**	9·9	10	**101·0**	20·9	28	**134·0**
A_{14} *and* A_{15}—*Unknown or Obscure Family History.*									
–37	22·6	13	**57·5**	21·1	20	**94·8**	43·7	33	**75·5**
38–52	13·0	9	**69·2**	15·0	18	**120·0**	28·0	27	**96·4**
Total	35·6	22	**61·8**	36·1	38	**105·3**	71·7	60	**83·7**
A + E—*Tuberculous Family History plus Personal Defect.*									
–37	12·8	14	**109·4**	15·0	17	**113·3**	27·8	31	**111·5**
38–52	9·2	7	**76·1**	12·9	10	**77·5**	22·1	17	**76·9**
Total	22·0	21	**95·5**	27·9	27	**96·8**	49·9	48	**96·2**

Family History of Non-Tuberculous Pulmonary Disease.

With regard to group A_{13}, which relates to family history associated with some pulmonary disease other than tuberculosis, and includes bronchitis, it may be said, on the whole, that the mortality both for male and female lives is worse than in the combined group A_9 to A_{12}, particularly at the older ages at entry. It is, therefore, apparent that at least as much weight must be given to the death of a relative from non-tuberculous pulmonary disease as from tuberculosis. It is possible that this may point rather to a family peculiarity, displaying itself in a general weakness in the lungs than to an actual hereditary transmission of the disease. As to the possibility of such family peculiarities, Sir Clifford Allbutt gives an instance in *The Practitioner* for January, 1913. "Such "a peculiarity," he says, "may be found in the particular "bronchiole of Hirschfeld, which in certain families is apt to "sag, and thus to make a dip in which the bacillus may defy "the cleansings of Nature. Such a tube may be more defective "on one side of the chest than on the other; and Turban showed, "accordingly, that a tendency to pulmonary tubercle is not "only an inherited proclivity, but in this family or that pre-"dominates on one side or the other."

Obscure and Unknown Family History.

It is generally considered that where a family history is obscure or unknown, there is a strong presumption that it is of a tuberculous nature. For this reason, such cases have been included in the general Group A, being classed as Sub-groups A_{14} and A_{15}. It will be noticed here, that for male lives the mortality is higher, on the whole, than in the case of the non-tuberculous pulmonary lives. Giving weight to the amount of data for male lives under endowment assurances, it would seem that the mortality is at least as unfavourable as that of lives combining tuberculous history with personal blemish.

In view of these facts it would appear that there are strong grounds for the presumption referred to, and more caution would seem to be needed in accepting such risks than where there is a known family history of pulmonary disease, whether tuberculous or not.

Tuberculous Family History coupled with Personal Blemish.

Finally, with regard to tuberculous family history associated with some personal blemish, there seems no doubt that the figures given may be relied upon as confirming the opinion, generally held, that from such a combination high rates of mortality are to be looked for.

Weight in Relation to Tuberculous History.

No doubt some valuable lessons might have been obtained by an investigation into Group A with regard to weight, but unfortunately, the data were not in a sufficiently advanced form to be included in this Paper.

Personal Blemish of a Tuberculous or Pulmonary Nature.

In dealing with Group E (page 73) several of the Sub-groups have been combined into sections. Of these sections those numbered II and IV refer to personal history of disease of a tuberculous or pulmonary nature, and Tables relating to those sections are inserted here (Tables XXX and XXXI). It will be observed that only the endowment assurance experience is given, as the whole-life was too small to admit of any deductions being drawn.

Table XXX.

Group E.—Section II.

Personal Blemishes of a Tuberculous or Pulmonary Nature.

Comparison of Actual Deaths with those Expected according to O^{M} *Table.*

(A) *First* 10 *years of Assurance.*

Endowment Assurances. *Males.*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
-37	21·0	26	**123·8**	19·4	23	**118·6**	40·4	49	**121·3**
38–52	6·4	14	**218·8**	5·8	9	**155·2**	12·2	23	**188·5**
Total	27·4	40	**146·0**	25·2	32	**127·0**	52·6	72	**136·9**

(B) *Ultimate Experience, excluding first* 10 *years of Assurance.*

Central Age Attained	Expected Deaths		Actual Deaths		Percentage
(1)	(2)		(3)		(4)
40	5·3	10·1	8	15	**148·5**
45	4·8		7		
50	3·6	8·8	1	10	**113·6**
55	3·0		2		
60	1·8		5		
65	·4		2		

Table XXXI.

Group E.—Section IV.

Personal Blemishes of a Tuberculous or Pulmonary Nature.
Comparison of Actual Deaths with those Expected according to O[M] *Table*

(A) *First* 10 *years of Assurance.*

Endowment Assurances. *Males.*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
–37	17·9	30	**167·6**	21·7	30	**138·2**	39·6	60	**151·5**
38–52	9·6	22	**229·2**	13·0	25	**192·3**	22·6	47	**208·0**
Total	27·5	52	**189·1**	34·7	55	**158·5**	62·2	107	**172·0**

(B) *Ultimate Experience, excluding first* 10 *years of Assurance.*

Central Age Attained	Expected Deaths		Actual Deaths		Percentage
(1)	(2)		(3)		(4)
40	8·0	17·7	18	35	**197·7**
45	9·7		17		
50	8·1	15·5	8	14	**90·3**
55	7·4		6		
60	5·5	7·0	4	5	**71·4**
65	1·5		1		

High Mortality where Personal History of Tuberculosis or Pulmonary Disease.

The exposures are very few, but, as might have been expected, the Tables confirm the commonly expressed opinion that, where there is a personal history of tuberculosis or pulmonary disease, the rates of mortality are much higher than where there is a family history of these diseases. This is the case even where the latter is associated with indifferent health or poor physique. In both these Tables it will be observed that the mortality is particularly high in the first five years of assurance for entry ages 38 to 52, and also in the Ultimate Table for central ages attained 40 and 45. These facts indicate that the excess mortality in these sections attains its maximum intensity between ages 40 and 50, after which there seems to be a marked improvement.

Group A. Causes of Death.

A common method of enquiry into problems connected with tuberculosis has been by analysing the causes of death amongst persons having a tuberculous family history. This method, of course, is not entirely satisfactory from an actuarial point of view; but, as it was possible that such an investigation might throw further light on some of these problems, the causes of death were examined and tabulated for endowment assurances on male lives in Sub-groups A_1 to A_{12}. The few cases in Sub-group A_0 were omitted, and all duplicates were excluded. As the object was to ascertain whether a tuberculous family history was associated with a preponderance of deaths from the same disease, the deaths from tuberculosis were compared with those arising from all causes.

The resulting totals, obtained in sections, are shown in Table XXXII, together with the figures obtained from a similar investigation of those deaths in 1910 amongst endowment assurances on male lives in which there was no tuberculous taint at the date of proposal.

Table XXXII.

Comparison of Deaths from Tuberculosis with Deaths from All Causes, in Groups of Ages at Death.

Endowment Assurances. *Males.*

Data	Ages at Death									
	20–24		25–34		35–44		45–54		55–64	
	Deaths from Tuberculosis	Deaths from All Causes	Deaths from Tuberculosis	Deaths from All Causes	Deaths from Tuberculosis	Deaths from All Causes	Deaths from Tuberculosis	Deaths from All Causes	Deaths from Tuberculosis	Deaths from All Causes
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Tuberculous Families:										
(α) Lineals	22	42	125	280	84	244	27	118	2	21
(β) Lineals plus Collaterals	4	8	44	72	36	104	29	103	1	34
(γ) Collaterals	22	34	146	279	168	500	66	352	18	127
Tuberculous Families ...	48	84	315	631	288	848	122	573	21	182
Non-Tuberculous Families (Deaths in 1910)	31	95	113	363	143	630	82	667	24	368

For purposes of comparison these totals require to be brought to a common denominator. Accordingly Table XXXIII sets out the comparison in the form of deaths from tuberculosis per 1,000 deaths from all causes. Included in this Table are the corresponding rates deduced from the Returns of the Registrar-General for England and Wales for the first, last, and central calendar years of the investigation.

Table XXXIII.

Comparison of Deaths from Tuberculosis with 1,000 Deaths from All Causes, in group of ages at Death.

Endowment Assurances. *Males.*

Data	Ages at Death				
	20–24	25–34	35–44	45–54	55–64
(1)	(2)	(3)	(4)	(5)	(6)
Tuberculous Families:					
(α) Lineals	523	446	344	229	95
(β) Lineals plus Collaterals	500	611	346	282	29
(γ) Collaterals	647	523	336	187	142
Tuberculous Families ...	571	499	340	213	115
Non-Tuberculous Families ... (Deaths in 1910)	326	311	227	123	65
Returns of Registrar-General of England and Wales:					
Deaths in 1893	407	363	269	161	80
,, 1901	399	375	291	183	81
,, 1910	428	389	274	167	77

Heavy Proportion of Deaths from Tuberculosis.

It will be seen at once that the mortality from tuberculosis amongst those having a family history of that disease is very much greater than amongst a similar body of assured lives having no such tainted history. It is even considerably greater than that shown

amongst the general population. There can be no doubt, in fact, that a family history of tuberculosis predisposes to death from that cause. As between the three sections—lineals, lineals plus collaterals, and collaterals—there does not seem to be any very decided difference after age 35. Below that age, there is apparent a tendency to a greater proportion of tuberculous deaths where the relative affected was a collateral. It is possible that the higher ratio of deaths below age 35 is due to the closer intercourse with the affected relative.

A very noticeable and somewhat disturbing feature of Table XXXIII, is the fact that the proportion of deaths due to tuberculosis shown in the Registrar-General's Returns, was practically the same in 1901 as in 1893, and in 1910 had even increased at ages below 35.

An investigation of a similar character was made by Dr. E. J. Marsh of the causes of death amongst persons assured in the Mutual Life Insurance Company of New York. It refers to the fifteen years 1879 to 1893, and apparently to lives of both sexes. The results are here reproduced in Tables XXXIV and XXXV, in a form slightly modified from the original. It will be seen that the age-groups lie midway between those given in this Paper, and that the resulting ratios also lie practically midway between those given in Table XXXIII. Such close correspondence confirms in a remarkable way the conclusions already drawn on this point.

Table XXXIV.

Experience of Mutual of New York (1879–1893).

Deaths from Consumption and from All Causes.

Data	Ages at Death									
	20–29		30–39		40–49		50–59		60–69	
	Consumption	All Causes	Consumption	All Causes	Consumption	All Causes	Consumption	All Causes	Consumption	All Causes
Consumptive Families ...	31	60	77	194	70	284	77	489	47	569
Non-consumptive Families ...	38	106	98	372	100	566	49	724	36	613

Reduced to the form of Deaths from Consumption to 1,000 Deaths from All Causes the Table is as follows :

TABLE XXXV.

Experience of Mutual of New York (1879–1893).
Deaths from Consumption per 1,000 *Deaths from all causes.*

Data	Ages at Death				
	20–29	30–39	40–49	50–59	60–69
Consumptive Families ...	516	396	246	157	82
Non-consumptive Families ...	358	263	176	67	58

Deaths from Tuberculosis according to Duration of Assurance.

The deaths in Group A were also examined according to the duration of assurance, and the resulting ratios per 1,000 deaths from all causes, are given in Table XXXVI.

TABLE XXXVI.

Family History of Tuberculosis. Combined Experience A_0 *to* A_{12}.
Deaths from Tuberculosis compared with 1,000 *deaths from All Causes, in years of Assurance.*

Endowment Assurances. *Males.*

Central Ages at Entry	Years of Assurance.				
	0	1	2–4	5–9	0–9
20–25	467	583	552	522	535
30–35	281	412	390	351	363
40–50	225	250	213	216	218
All Ages	322	449	396	360	377

It will be seen that the ratio of deaths from tuberculosis to those from all causes reaches a maximum in year of assurance "1," and then diminishes.

The Table may be said to show that the comparatively high rate of mortality exhibited for the younger ages at entry in the early years of assurance is due to an excess of deaths from tuberculosis.

Correlation of Ages at Death.

An investigation was made to ascertain whether there was any correlation between the ages at death of those who died from tuberculosis and the age at death of the tuberculous relative.

The male lives assured under endowment assurances were selected for this enquiry and the groups investigated were those in which only one relative had died from tuberculosis. The results are shown in Tables XXXVII and XXXVIII, and are interesting chiefly from their negative character. In neither of the Tables is there any indication of correlation between the ages at death of the relative and of the assured.

It would have been interesting, had it been possible, also to have investigated the effect of the length of the period elapsed between the death of the relative and the date of entry into assurance, but the proposals did not give the necessary information.

TABLE XXXVII.

Deaths from Tuberculosis. *Sub-groups* A_1 *and* A_2.

Age at Death of Assured, where Death resulted from Tuberculosis, compared with Age at Death of Father or Mother from Tuberculosis.

Endowment Assurances. *Males*

Central Age at Death of Assured	Central Age at Death of Father or Mother									Total	Mean Age at Death of Father or Mother
	20	25	30	35	40	45	50	55	60		
20	...	...	1	1	2	...	3	...	...	7	42·1
25	...	...	3	13	12	7	6	3	...	44	41·0
30	...	1	5	16	7	9	8	4	1	51	41·2
35	1	3	5	9	11	3	11	3	2	48	41·0
40	...	...	4	9	5	7	4	2	2	33	41·8
45	...	...	4	5	5	3	4	...	...	21	39·5
50	...	...	1	...	1	3	...	...	1	6	44·2
55	...	1	...	...	...	4	1	...	...	6	42·5
60	...	...	...	...	...	...	...	1	...	1	55·0
Total	1	5	23	53	43	36	37	13	6	217	41·3
Mean Age at Death of Assured	35·0	38·0	35·2	32·5	32·8	37·1	33·2	33·8	38·3	34·1	...

TABLE XXXVIII.

Deaths from Tuberculosis. Sub-group A_{11}.

Age at Death of Assured, where Death resulted from Tuberculosis, compared with Age at Death of Brother or Sister from Tuberculosis.

Endowment Assurances. *Males.*

Central Age at Death of Assured	Central Age at Death of Brother or Sister.									Total	Mean Age at Death of Brother or Sister
	10	15	20	25	30	35	40	45	50		
20	...	...	2	4	...	...	...	...	...	6	23·3
25	4	2	20	8	3	1	...	...	...	38	20·9
30	4	8	18	14	11	2	1	...	...	58	22·6
35	1	6	21	13	14	5	3	1	...	64	25·1
40	1	6	12	5	8	8	4	2	...	46	26·8
45	...	2	6	18	4	5	1	...	1	37	26·6
50	...	3	2	8	2	1	5	...	...	21	27·6
55	1	1	...	1	2	...	...	...	...	5	22·0
60	...	...	...	2	...	2	...	...	...	4	30·0
Total	11	28	81	73	44	24	14	3	1	279	24·7
Mean age at Death of Assured.	31·8	37·0	32·9	37·5	36·5	40·6	42·1	38·3	45·0	36·3	...

Historical Summary of Attitude of Medical Profession.

Before finally leaving this subject, it may be thought not out of place to say a few words with regard to the medical point of view. Since Koch's discovery of the tubercle bacillus in 1882 and the advent of tuberculin treatment, the whole attitude of the medical profession has completely changed. Prior to that date, however, very widely differing views had been held all down the ages, from the very dawn of medical science. They are well summed up by Dr. L. K. Harrison in a Paper published in Vol. XIII of the *Journal of the Insurance Institute*: "Hippocrates, 400 B.C., believed in the curability of phthisis in all "its stages, and in the benefits of change of residence. Aristotle "also noted that, among the Greeks of his day, it was generally "considered to be contagious. The theories as to its causation "have undergone many changes. The celebrated Sylvius, "writing in 1695, believed it to be contagious. Morton believed "in contagion and in hereditary influences. Morgagni regarded "it as extremely infectious, and refrained from doing autopsies "on consumptives. . . . At the end of the eighteenth century "the belief in contagion was universal, but in varying degree. . . . "During the early part of the nineteenth century, the belief in "contagion was lessened by Laennec, who drew particular "attention to the tubercular diathesis, predisposition, and "heredity. . . . Virchow believed in an inherited and acquired "pre-disposition, which required no mysterious contagion "to excite the disease. Writing in 1893, Dr. F. Taylor says, "'Nothing seems better established than the truth of the "'hereditary transmission of phthisis.' . . . It was Koch's "discovery of the bacillus that formed the death-blow to the "theory of heredity."

Differences of Opinion at the present time.

At the present time there may be said to be two schools or camps of opinion. Both are agreed that tuberculosis is of an infectious nature. They differ mainly on the subject of heredity. Into the merits of these conflicting opinions we do not propose to enter. We propose merely to set out, briefly, their differing points of view, and the consequent effect on the treatment of proposals for life assurance.

Medical Opposition to "Heredity" Theory.

The case of those who are opposed entirely to any theory of heredity, and believe solely in infection, is summed up in Dr. Harrison's Paper,

to which we have already referred: "Upon enquiry into "the facts upon which the theory of heredity in phthisis "was based, I found that the one argument was the "repeated occurrence of the disease in several members of one "family; and it at once suggested itself to me, that as phthisis "used to be so common, it would follow, as a matter of course, "that a history of consumption 'in the family' would almost "of necessity be frequently found." "To prove hereditary "transmission we must show that consumption is distinctly more "common in the families of the tubercular than the normal "incidence in the population generally, and this fact has not "yet been demonstrated. And, even if we did find that the "children of consumptives were more frequently affected than "those of non-consumptives, this would not prove hereditary "transmission, as the greater frequency would be due to greater "opportunities of infection. If hereditary influence were a "real and potent cause, we should expect to find that after "removal of the child from his tubercular parent, and pro-"tecting him as far as possible from infection, he would still "become tubercular, but this is far from being the case." "Many so-called cases of heredity have included parents "who did not become phthisical till long after their children "had been born, and could not possibly be examples of "heredity."

He goes so far, however, as to admit that "There is no "doubt that the children of consumptive parents are often "delicate and of poor physique, and have a low resisting-power "and peculiar receptivity to all sorts of disease."

He qualifies this, however, by the further statement that "Tuberculosis does lead to an appreciable amount "of immunity in the offspring, of course not absolute, but "sufficient for us to notice an increased resistance to infection, "and an increased tendency to recover."

Effect of "Non-Heredity" Theory on Life Assurance.

The effect of the acceptance of the theory of this school upon the attitude of Life Assurance Companies cannot be put better than in the words of Dr. Otto May, in a recent Paper, "*Some Notes on Life Assurance*": "There is, however, ample and conclusive "evidence that the disease can be contracted by close "contact with persons suffering from phthisis, and that "such infection is facilitated by insanitary surroundings. "Yet most Assurance Companies at the present time pay no

"attention to these questions; they seek no information as to "the nature of the contact between the healthy and the infected "members of the family; the surcharge is the same whether "the tuberculous member lived in the same house with the "proposer, or in another continent, at and since the time the "infection declared itself. A similar anomaly shows itself in "the Companies' dealings with tuberculosis in married life. A "widower is often accepted at first-class rates three months "after the death from phthisis of his wife with whom he had "been living in the closest relationship up to the day of her "death. True, that in this case the hypothetical 'heredity' "factor is absent, but could one conceive more favourable "conditions for direct infection? And it is quite impossible "to measure in months the latent period before such infection "may become manifest to physical examination.

"In all probability future work will reduce the 'heredity' "factor to a much lower rank, if it does not abolish it altogether, "and will focus attention on the influence of environment, "including contact with infection, nature of work, and mode of "livelihood."

Definition of "Heredity."

On the other hand, many eminent authorities consider that heredity is an essential element to be reckoned with. It must be remembered, however, that the term "heredity" in this connection is usually employed in a special sense to denote, not the actual transmission of the disease itself, but the transmission of a more or less enfeebled constitution, or, rather, of a condition of the system which offers favourable soil for the propagation of the bacillus.

Thus Dr. Leslie Ogilvie in the *Transactions of the Actuarial Society of Edinburgh*, Vol. IV, says: "I do not deny that "perhaps in the great majority of instances it is not the disease "itself which is inherited, but either an inability of the cellular "structures of the body to resist the inroads of special organisms, "or a liability to degenerate in special ways. . . . The crucial "question is, 'Do we, or do we not, inherit enfeebled or robust "'constitutions from our ancestors?' I emphatically answer "'Yes'; and I therefore think that the family history is a "consideration of great weight in medical examination for life "Assurance." In regard to this, the words of Dr. Ferdinand Hueppe may be called to mind: "Disease is the result of a "number of factors, of which external conditions form one,

"the condition of the body another, and the presence of bacteria "a third."

Sir R. Douglas Powell in a Paper on "*The Prevention of Consumption*", read before the Sanitary Congress at Glasgow in 1904, remarks: "Looked at more broadly, however, the "facts shape themselves rather to the conclusion that the "poison is a distributed one and only in exceptional cases "communicated directly from person to person. . . . Now this "almost universal potential presence of the disease suggests, "amongst many other lessons, an almost universally distributed "virus rather than what we understand by person-to-person in-"fection." He quotes in support of this the absence of the influence of husband upon wife, or *vice versâ*, where one of them is consumptive.

The "Heredity" Theory.

Dr. Horder, writing in *The Practitioner* for January 1913—which contains a mine of information on the subject of tuberculosis—cautiously states the case for heredity: "The existence of tuberculous "families is one of the cardinal facts of clinical medicine. "It may be that a part of this familial incidence to "tuberculosis is explained by similarities in the life and "environment of the various individual members of the "family, allowing of the same sources of infection, but this "cannot explain the undoubted prevalence of tuberculosis in "parents, brothers and sisters, where the family is scattered, a "circumstance commonly seen. There is a tissue suscep-"tibility, a 'favourable soil,' that constitutes a potent element "in the pathology of the disease." He adds, however, that the "essence of this pre-disposition is at present unknown to us."

Sir Clifford Allbutt, in his masterly summing up of the discussion in *The Practitioner*, says: "The hereditary aspect "of tuberculosis takes no great space: congenital tubercle is "treated as little more than a curiosity; and if one or two "writers are disposed to ignore the influence of heredity, others "confine it to an inheritance of defective resistance. . . . I "would oppose the too frequent assumption that the victims of "tuberculosis are, after all, weaklings whose weeding out, if "painful to their friends, is, on the whole, good for the stamina "of the race. It is true that by inheritance, or by privation, "a person may be so debilitated as to offer a lessened resistance "to any injurious influence from without; but, on the other "hand, in respect of tubercle, such a lack may mark a family

"from generation to generation, as a peculiarity rather than a "frailty. . . . Such a constitution is as a lock, which may be "shut to every key but one. Bar the tubercle, and such a "one may continue strong and beautiful."

Dr. Lister, writing in the same Journal on "*Pulmonary Tuberculosis in relation to Life Insurance*", says: "To-day, "I recognise that in spite of the great importance of the hygienist "and immunist in modern treatment, such matters as hereditary "and acquired vulnerability, and bad environment must "still, in our insurance practice, be granted at least as much "consideration as I ascribed to them in my lecture published in "*The Practitioner* of 1903. They are the essential factors in the "causation of infection by a bacillus which is ubiquitous, and "afford us the measure of relative immunity in any individual "coming before us for life insurance examination."

Professor Pearson on Marital Infection.

The controversy between Prof. Karl Pearson and Dr. Newsholme on the subject is well known, and it is not intended to discuss it here, but it led to a series of investigations by the Francis Galton Laboratory, the results of which are appearing in a series of "Research Memoirs." In one of the first to appear, entitled, "*A Second Study of the Statistics of Pulmonary Tuberculosis: Marital Infection, by the late E. G. Pope*", 1908, edited by Prof. Karl Pearson, the latter refers to the subject of marital infection, where obviously infection should have its most marked effect. "A belief in infection between man and wife", he says, "has "been accepted by many on account of their clinical experience, "but until such experience has been definitely recorded and "analysed, it can in no way be considered as a scientific "demonstration. It may, therefore, be said that, up to the "present, no logical proof of marital infection in tuberculosis "has been given." He summarizes his conclusions in the following words: "Let us assume that the whole degree "of resemblance as to the tuberculous condition is due to "infection. Then we are confronted with the remarkable "result, that while the degree of resemblance between husband "and wife is not more than ·17 or, possibly, ·25 at a maximum, "that between parent and child is about ·4 to ·6, and that "between brothers about ·4 to ·5. . . . To rationalize such "results we are bound to consider that the inheritance of the "constitution is the vital matter, and that infective action "plays a subordinate roll."

Professor Pearson on Tuberculosis and Heredity.

In a further brochure, published in 1911, he comes to the conclusion "that clinically obvious "and apparent tuberculosis appears to be inherited "at precisely the same rate as stature or cubit, or "insanity, impressed me from the outset as remarkable evidence "for the constitutional-immunity factor being of more "importance than the infection factor. . . . I failed to "find in current medical works on the subject anything in- "dicative of a logical statistical investigation of the problem."

Tuberculin Test for Proposers.

Closely connected with the medical aspect is the question of the use of tuberculin as a test in examinations for life assurance. It would have been scarcely necessary to refer to this matter, but for the fact that within the past few months this test has been seriously put forward in two prominent assurance journals—one in this country and the other in Canada. In the one, the tuberculin test for proposers is suggested as the one sure and certain panacea for all problems as to tuberculosis which confront us in the acceptance of risks, and it is suggested that Offices not adopting it should be treated as too old-fashioned to be deserving of consideration. In the other, the demand—put forward by a medical man—is equally clamant: "In fact I would go further, and I think that the time "is not far distant, when each and every Insurance Company "shall insist on a tuberculin test being used in lung examinations, "even where no physical defect can be found. The test is "simple, and I do not see why it is not insisted on now. . . . "There are other tests to answer the same purpose, but none "so simple. Now if the results are beyond doubt, and the "procedure is simplicity itself, why is it not generally adopted "when such an issue means so much for all concerned? A "benefit for all and hardship for none."

Here there is not the least warning that using tuberculin for such purposes is playing with an exceedingly dangerous edged-tool. The fact is that any one of the dozen or so different kinds in use at the present time may have the effect of setting latent or sealed foci into action, thus producing active tuberculosis where it might have remained inactive for years, if not for ever. It is easier to imagine than to describe the estimation in which the public would hold a Company adopting a test, producing, even in only a few instances, such a result. As Dr. Priestley remarks, in referring generally to the use of tuberculin, the schemes are young, and caution is needed before

making *ex-cathedra* statements. Sir Clifford Allbutt leaves us no reasonable doubt on the matter : " The reader will look eagerly " for some lead as to early diagnosis by tuberculin, but not " altogether with reward. If he collects opinions from many " writers in this series, he will find rather a discordant note ; " some of the authors are emphatically in favour of its use, others " are more cautious or more timid. . . . On one point there is " a curious difference of opinion; namely, that while most " physicians seem agreed that the use of tuberculin in diagnosis " is followed by an exacerbation, or, at least, an awakening, of " the focus, Dr. Wilkinson denies this, and asserts that, on the " contrary, it has a sedative effect upon it. Those who think " there is a local awakening generally comfort us by the " assurance that this re-awakening does no harm. It may do no " harm in a focus already not inactive ; it may even modify " it in some favourable way ; but what about some other focus, " dormant and unsuspected, on the way to obsolescence ? The " general practitioner will desire some more solid assurances " than are provided in these Papers, before he will trust himself, " for diagnostic purposes, to arouse reactions which might be " injurious. There is too much at stake ; and even for the " expert, the number of ' normals ' (or persons practically normal) " who react is embarrassing."

Personal History of Rheumatic Fever, and Lesions of the Circulatory System.

It will be seen from the Summary of Data (Table VII) that in total Group B, dealing with Personal History of Rheumatic Fever and Lesions of the Circulatory System, included 65,744 years of life, and that 1,074 deaths were recorded.

An investigation was first made of the experience of the group as a whole under whole-life and endowment assurances respectively on male lives, and under endowment assurances on female lives. This was carried out on precisely the same lines as in Group A, and the following Tables show the result for the first 10 years of assurance.

Table XXXIX.

Group B. *Rheumatic Fever and Circulatory Lesions.*

Comparison of Actual Deaths with those Expected according to O[M] *Table.*

First 10 *years of Assurance.*

Whole-Life Assurances. *Males.*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
–37	7·2	8	**111·1**	14·6	30	**205·5**	21·8	38	**174·3**
38–52	16·6	37	**222·9**	31·8	57	**179·2**	48·4	94	**194·2**
53–62	11·1	18	**162·2**	26·4	31	**117·4**	37·5	49	**130·7**
Total	34·9	63	**180·5**	72·8	118	**162·1**	107·7	181	**168·1**

Table XL.

Group B. *Rheumatic Fever and Circulatory Lesions.*

Comparison of Actual Deaths with those Expected according to O[M] *Table.*

First 10 *years of Assurance.*

Endowment Assurances. *Males.*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
–37	56·8	60	**105·6**	71·8	62	**86·4**	128·6	122	**94·9**
38–52	33·2	46	**138·6**	49·1	59	**120·2**	82·3	105	**127·6**
Total	90·0	106	**117·8**	120·9	121	**100·1**	210·9	227	**107·6**

Table XLI.

Group B. *Rheumatic Fever and Circulatory Lesions.*

Comparison of Actual Deaths with those Expected according to O[M] *Table.*

First 10 *years of Assurance.*

Endowment Assurances. *Females.*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
-37	11·3	12	**106·2**	14·8	17	**114·9**	26·1	29	**111·1**
38–52	7·8	5	**64·1**	11·7	10	**85·5**	19·5	15	**76·9**
Total	19·1	17	**89·0**	26·5	27	**101·9**	45·6	44	**96·5**

High Mortality in Group B.

Except that the Tables indicate a high rate of mortality, particularly in the early years of assurance, and to a much greater extent under whole-life than under endowment assurances, there is no very clear indication of the tendency of the results, and it was felt that further investigation was desirable. Examination of the figures in Tables XXXIX and XL with the corresponding Ultimate experiences suggested that the mortality of the early years of assurance was no better than that experienced after the expiration of 10 years. To test this, the data were recast into aggregate form showing in parallel columns the expected and actual deaths for quinquennial groups of ages attained in the full aggregate Table, and the truncated aggregate Tables excluding the first 5 and excluding the first 10 years of assurance respectively. The expected deaths were throughout calculated by means of the O[M] Ultimate Table, thus eliminating the effect of selection.

This experiment showed that, on the whole, and particularly at the younger attained ages, both for whole-life and for endowment assurances, a heavier rate of mortality was exhibited during the first 5 and first 10 years of assurance than in the Ultimate Tables excluding the first 10 years of assurance.

Personal History of Rheumatic Fever.

The data, though considerable, were not sufficient to enable a detailed examination to be made of the rates of mortality in the sub-groups indicated in the Classification Schedule, but it will be observed that the Sub-groups fall naturally into two sections, namely, (1) those which had a personal history of Rheumatic Fever which apparently had not affected the heart (Sub-group B_1), and (2) the remainder of the Group, namely, those in which there was some definite, though slight, impairment of the circulatory system. As each of these sections consisted of a fair number of cases, it was considered desirable to investigate them separately to see whether there were any marked differences between them.

The results of this enquiry are set out in the following Tables, which all refer to male lives. Tables XLII and XLIII give the figures for whole-life assurances, and Tables XLIV and XLV for endowment assurances. It should be pointed out that the same standard of comparison has been adopted throughout in the calculation of the expected deaths under these Tables, namely, the $O^{[M]}$ Ultimate Table.

Table XLII

Sub-Group B_1. *Personal History of Rheumatic Fever.*

Comparison of Actual Deaths with those Expected according to O[M] *Ultimate Table.*

Whole-Life Asssurances. *Aggregate Tables.* *Males.*

Central Age Attained. (1)	Full Aggregate			Excluding First 5 Years of Assurance			Excluding First 10 Years of Assurance		
	Expected Deaths (2)	Actual Deaths (3)	Percentage (4)	Expected Deaths (5)	Actual Deaths (6)	Percentage (7)	Expected Deaths (8)	Actual Deaths (9)	Percentage (10)
30	2·6	...		·9	...		·1	...	
35	6·2 — 8·8	11 — 11	**125·0**	3·2 — 4·1	8 — 8	**195·1**	1·2 — 1·3	1 — 1	**76·9**
40	11·6	20		8·3	14		3·8	4	
45	19·3 — 30·9	30 — 50	**161·8**	15·2 — 23·5	19 — 33	**140·4**	9·7 — 13·5	10 — 14	**103·7**
50	28·0	42		23·1	34		16·7	24	
55	37·3 — 65·3	54 — 96	**147·0**	31·7 — 54·8	47 — 81	**147·8**	24·7 — 41·4	36 — 60	**144·9**
60	39·6	47		35·5	44		28·1	38	
65	34·2 — 73·8	36 — 83	**112·5**	33·1 — 68·6	33 — 77	**112·2**	26·3 — 54·4	29 — 67	**123·2**
70	27·5	33		27·3	32		24·2	30	
75	16·2 — 43·7	19 — 52	**119·0**	16·2 — 43·5	19 — 51	**117·2**	15·6 — 39·8	19 — 49	**123·1**

TABLE XLIII.

Group B (*excluding Sub-group* B_1). *Personal History of Diseases of Circulatory System.*

Comparison of Actual Deaths with those Expected according to $O^{[M]}$ *Ultimate Table.*

Whole-Life Assurances. *Aggregate Tables.* *Males.*

Central Age Attained	Full Aggregate			Excluding First 5 Years of Assurance			Excluding First 10 Years of Assurance		
	Expected Deaths	Actual Deaths	Percentage	Expected Deaths	Actual Deaths	Percentage	Expected Deaths	Actual Deaths	Percentage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
30	1·6	4		...	...		...	...	
35	3·8 (5·4)	3 (7)	129·6	2·2 (2·2)	3 (3)	136·4	·7 (·7)	1 (1)	142·9
40	6·9	7		4·9	5		2·3	2	
45	10·7 (17·6)	21 (28)	159·1	8·1 (13·0)	20 (25)	192·3	5·1 (7·4)	14 (16)	216·2
50	14·9	33		11·0	26		7·4	15	
55	20·4 (35·3)	31 (64)	181·3	15·1 (26·1)	28 (54)	206·9	9·9 (17·3)	18 (33)	190·8
60	24·9	28		21·2	24		13·4	16	
65	23·3 (48·2)	29 (57)	118·3	22·4 (43·6)	29 (53)	121·6	16·8 (30·2)	19 (35)	115·9
70	18·0	27		17·7	27		15·2	22	
75	9·2 (27·2)	12 (39)	143·4	9·2 (26·9)	12 (39)	145·0	7·8 (23·0)	10 (32)	139·1

TABLE XLIV

Sub-Group B_1. *Personal History of Rheumatic Fever.*

Comparison of Actual Deaths with those Expected according to $O^{(M)}$ *Ultimate Table.*

Endowment Assurances. *Aggregate Tables.* *Males.*

Central Age Attained	Full Aggregate			Excluding First 5 Years of Assurance			Excluding First 10 Years of Assurance		
	Expected Deaths	Actual Deaths	Percentage	Expected Deaths	Actual Deaths	Percentage	Expected Deaths	Actual Deaths	Percentage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
30	26·8	13		11·4	6		1·5	...	
35	38·1 } 64·9	27 } 40	**61·6**	22·6 } 34·0	18 } 24	**70·6**	7·5 } 9	8 } 8	**88·9**
40	44·7	35		31·0	23		15·3	10	
45	47·5 } 92·2	35 } 70	**75·9**	36·5 } 67·5	23 } 46	**68·1**	20·2 } 35·5	11 } 21	**59·2**
50	40·8	42		34·0	37		21·3	19	
55	27·7 } 68·5	23 } 65	**94·9**	24·8 } 58·8	21 } 58	**98·6**	16·9 } 38·2	16 } 35	**91·6**
60	15·1	24		14·7	24		11·3	17	
65	3·4 } 18·5	1 } 25	**135·1**	3·4 } 18·1	1 } 25	**138·1**	3·2 } 14·5	... } 17	**117·2**

Table XLV.

Group B (*excluding Sub-group* B_1). *Personal History of Diseases of the Circulatory System.*

Comparison of Actual Deaths with those Expected according to $O^{[M]}$ *Ultimate Table.*

Endowment Assurances. *Aggregate Tables.* *Males.*

Central Age Attained	Full Aggregate			Excluding First 5 Years of Assurance			Excluding First 10 Years of Assurance		
	Expected Deaths	Actual Deaths	Percentage	Expected Deaths	Actual Deaths	Percentage	Expected Deaths	Actual Deaths	Percentage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
30	18·1 } 42·7	10 } 32	**74·9**	7·5 } 22·6	4 } 14	**61·9**	1·1 } 6·8	1 } 5	**73·5**
35	24·6 }	22 }		15·1 }	10 }		5·7 }	4 }	
40	28·4 } 54·9	33 } 64	**116·6**	20·4 } 40·1	23 } 42	**104·7**	11·4 } 23·8	13 } 22	**92·4**
45	26·5 }	31 }		19·7 }	19 }		12·4 }	9 }	
50	24·2 } 42·3	24 } 40	**94·6**	17·7 } 32·8	19 } 34	**103·7**	10·6 } 19·5	13 } 18	**92·3**
55	18·1 }	16 }		15·1 }	15 }		8·9 }	5 }	
60	10·1 } 11·4	11 } 14	**122·8**	9·8 } 11·1	10 } 13	**117·1**	6·7 } 7·6	6 } 8	**105·3**
65	1·3 }	3 }		1·3 }	3 }		·9 }	2 }	

Rheumatic Fever and Heart Disease.

Comparing Table XLII with Table XLIII, and Table XLIV with Table XLV, it will be seen that the mortality amongst those who had definite heart lesions is higher on the whole than amongst those who had a history of rheumatic fever without resulting heart affection. The higher mortality is particularly marked below age 60 in the Ultimate Table under whole-life assurances. For central ages 50 and 55 under whole-life assurances, and for ages 40 and 45 under endowment assurances, in the Full Aggregate Tables, the difference in favour of Sub-group B_1 is very marked. These are the ages at which the difference is of most consequence, and it will be observed that they relate to the groups which contain the largest number of actual deaths.

In each of these Tables the excess mortality attains a maximum between ages 45 and 60 and subsequently diminishes, though rather slowly. In the whole-life assurances it is still a prominent feature of the curves at age 75.

The Tables show that a personal history of rheumatic fever, though the heart exhibits no sign of impairment, must be viewed with considerable caution. Those cases in which the heart is actually affected, though the impairment is slight and not sufficient to warrant rejection, must be treated even more stringently, particularly in middle life.

Causes of Death in Group B.

An investigation was made into the causes of death in Group B, amongst whole-life assurance on male lives, and the results are shown in Table XLVI.

TABLE XLVI.

Group B. *Comparison of Deaths from Rheumatic Fever and Heart Disease with Deaths from All Causes.*

Whole-Life Assurances. *Males.*

Data	Causes of Death	Ages at Death					
		25–34	35–44	45–54	55–64	65–74	75–
Sub-group B_1	Rheumatic Fever ...	...	3	7	2	1	...
	Heart Disease	1	6	26	25	20	5
	All Causes ...	6	35	83	96	67	22
Group B excluding Sub-Group B_1	Rheumatic Fever ...	...	...	3	1	...	...
	Heart Disease	2	7	20	19	12	3
	All Causes ...	4	17	57	59	48	15

In Table XLVII the figures are given in the form of ratios to 1,000 deaths from all causes, and corresponding figures, extracted from the Returns of the Registrar-General for England and Wales for 1901 and 1910, are furnished for comparison.

TABLE XLVII.

Group B. *Comparison of Deaths from Rheumatic Fever and Heart Disease with 1,000 Deaths from All Causes.*

Males.

Data	Causes of Death	Ages at Death					
		25–34	35–44	45–54	55–64	65–74	75–
Sub-Group B_1 Whole Life Assurances	Rheumatic Fever ...	...	86	85	21	15	...
	Heart Disease	167	171	313	260	299	227
Group B excluding Sub-Group B_1 Whole Life Assurances	Rheumatic Fever ...	...	...	53	17	...	...
	Heart Disease	500	412	351	322	250	200
Returns of Registrar-General for England and Wales, 1901	Rheumatic Fever ...	15	12	12	12	13	8
	Heart Disease	74	99	130	176	180	112
Returns of Registrar-General for England and Wales 1910	Rheumatic Fever ...	10	8	7	8	9	6
	Heart Disease	73	104	141	183	181	113

It will be seen that the assured have died in much greater proportion from the causes for which they were classed as sub-normal than have persons in the general population, and that the maximum intensity is attained at an earlier age, namely, in the age group 45–54 instead of in the age group 55–64 as shown by the Registrar-General's figures.

Medical Aspect of Heart Affections.

It is necessary to bear in mind that, as in the case of tuberculosis, the medical point of view has radically changed in recent years. This may have a considerable effect in modifying the future practice of Life

Offices. The change is due mainly to the researches of Dr. James Mackenzie. His observations showed him that "the "forces of the heart may be considered as being composed of "two kinds—a 'rest' force, sufficient to maintain an efficient "circulation when the body is at rest, and a 'reserve' force, "which is called into play when the body or any part of it is "called into activity." That is to say, that the condition of the heart muscle, and its action, are the two all-important considerations. Arguing from this basis, he concludes that "the presence of any sign revealed by physical examination, "however abnormal it may seem, is of no serious significance "so long as it is the only sign present, or so long as there is no "limitation of the reserve force of the heart." In a Paper recently read before the Life Assurance Medical Officers' Association, he applies his principles to life assurance examinations in the following words. "If we search medical literature for "any description of these manifestations of diseased heart "muscle sufficiently precise to enable the reader to recognize "and measure their value, we shall search in vain. As a con- "sequence, it is rarely used in a practical manner. If you "desired evidence for this statement, I would refer you to the "reports, which you, as medical examiners, are asked to fill up. "There are questions relating to the size of the heart, its rate "and rhythm, to the character of the sounds, but not a single "question directed to the most important class of evidence, to "the evidence which gives you the really essential information "on which to base a prognosis of the patient's future. Nay, "more, some Insurance Companies have special heart forms, "designed to be filled up when any abnormal sign is perceived. "I have seen such forms, and, though there was a series of "questions to be answered, there was not one designed to supply "the essential information."

Obesity.

In the group referring to obesity (Group D), Hutchinson's Tables were taken as a rough standard of the relation of weight to height. Considerable deviations were, however, allowed on either side; but it is impossible to give any statistical statement as to the amounts of such deviations, as each case was considered on its merits with special reference to occupation, general habits, family history, and any other matters bearing on the subject. The cases actually included in the

group were those that were considerably over the standard weight and outside the limits of such deviations, and accordingly consisted of all those that were rated up as sub-standard lives. The results are shown in Tables XLVIII, XLIX, and L.

The mortality for whole-life assurances is heavy throughout; also it is noticeable that the rates in the ultimate experience are very high. Under endowment assurances the rates both for male and female lives are much lighter for the first ten years of assurance. Here again the assured have discriminated in their choice of policy, the pessimists choosing whole-life contracts while the optimists have cheerfully paid the higher premiums under endowment assurances.

Table XLVIII.

Group D.—*Obesity.*

Comparison of Actual Deaths with those Expected according to O[M] *Table.*

(A) *First* 10 *years of Assurance.*

Whole-Life Assurances. *Males.*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
–37	3·8	6	**157·9**	4·3	7	**162·8**	8·1	13	**160·5**
38–52	37·8	63	**166·7**	43·5	85	**195·4**	81·3	148	**182·0**
53–62	37·0	58	**156·8**	40·9	63	**154·0**	77·9	121	**155·3**
Total	78·6	127	**161·6**	88·7	155	**174·7**	167·3	282	**168·6**

(B) *Ultimate, excluding first* 10 *years of Assurance.*

Central Age Attained	Expected Deaths	Actual Deaths	Percentage
(1)	(2)	(3)	(4)
40	·6	4	
45	1·8 } 2·4	2 } 6	**250·0**
50	4·4	13	
55	10·0 } 14·4	22 } 35	**243·1**
60	17·2	27	
65	23·1 } 40·3	37 } 64	**158·8**
70	19·9	33	
75	8·9 } 28·8	13 } 46	**159·7**

Table XLIX.

Group D. *Obesity.*

Comparison of Actual Deaths with those Expected according to O[M] *Table.*

(A) *First* 10 *years of Assurance.*

Endowment Assurances. *Males.*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
-37	29·1	29	**99·7**	28·2	36	**127·7**	57·3	65	**113·4**
38–52	55·2	53	**96·0**	58·2	87	**149·5**	113·4	140	**123·5**
Total	84·3	82	**97·3**	86·4	123	**142·4**	170·7	205	**120·1**

(B) *Ultimate, excluding first* 10 *years of Assurance.*

Central Age Attained	Expected Deaths		Actual Deaths		Percentage
(1)	(2)		(3)		(4)
40	3·2	8·8	6	11	**125·0**
45	5·6		5		
50	8·6	18·9	16	42	**222·2**
55	10·3		26		
60	9·3	11·1	12	18	**162·2**
65	1·8		6		

Table L.

Group D. *Obesity.*

Comparison of Actual Deaths with those Expected according to O[M] *Table*

First 10 *years of Assurance.*

Endowment Assurances. *Females.*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
–37	5·9	4	**67·8**	6·6	7	**106·1**	12·5	11	**88·0**
38–52	21·6	23	**106·5**	26·1	39	**149·4**	47·7	62	**130·0**
Total	27·5	27	**98·2**	32·7	46	**140·6**	60·2	73	**121·3**

Group D. Causes of Death.

In this Group also an analysis was made of the causes of death. This is given in Table LI, which shows that they consist mainly of affections of the circulatory system. The deaths of a tuberculous nature were very few. These results are in general agreement with other published experiences of "heavy-weight" lives.

Table LI.

Group D. *Obesity.*

Whole-Life Assurances. *Causes of Death.* *Males.*

Cause of Death (Reference to Schedule page 7)	Ages at Death							
	35–44		45–54		55–64		65–74	
	No. of Deaths	Per 1000 Deaths from All Causes	No. of Deaths	Per 1000 Deaths from All Causes	No. of Deaths	Per 1000 Deaths from All Causes	No. of Deaths	Per 1000 Deaths from All Causes
6–9	2	87	14	113	25	135	15	163
11	5	217	31	250	42	227	29	315
12–14	3	130	14	113	20	108	15	163
15–16	2	87	9	73	29	156	5	54
23–24	1	44	15	121	30	162	11	120
Other Causes	10	435	41	330	39	212	17	185
All Causes	23	1,000	124	1,000	185	1,000	92	1,000

Personal Blemishes not included in other Groups.

In point of magnitude of material the Group relating to general personal blemishes (Group E) comes next to that dealing with tuberculous family history. But even so, it was insufficient to justify investigation into each of the 52 sub-groups into which it had been divided. The blemishes were classified as they came to the notice of Dr. Light in the examination of the proposals, and this accounts for the somewhat disconnected appearance of the classification.

Schedule showing the Sub-groups of which Group E was composed.

1. Presence of Cicatrices of old Tuberculous Glands.
2. Not Robust—Poor Physique, Delicate, Anæmic-looking.
3. Dyspepsia.
4. Infantile Paralysis.
5. Hæmoptysis.
6. Nervous disposition.
7. Fair or indifferent health.
8. Old Hip-joint or other Tuberculous Bone Disease.
9. Pigeon Breast or other Chest malformation.
10. Varicose Veins.
11. Pleurisy, Pneumonia or Empyema.
12. Hernia.
13. Lupus.
14. Fistula.
15. Spinal Curvature—(*a*) Angular, (*b*) Lateral.
16. Bronchitis.
17. Lungs unsatisfactory (Emphysema, &c.).
18. Epilepsy.
19. Appendicitis.
20. Stricture.
21. Renal Calculus.
22. Ear Disease.
23. Goitre.
24. Gravel.
25. Syphilis.
26. Deafness.
27. Operation for some innocent growth.
28. Gall-stones.

29. Dumb.
30. Looks older.
31. Lead Poisoning.
32. Albumen.
33. Ulcer of the stomach.
34. Nephritis.
36. Tuberculous Lesion or Incipient Phthisis in the past.
37. Coloured Person.
38. Traumatic Lesion, Fractured Skull, Concussion, &c.
39. Practically Blind.
40. Congenital Malformation, other than Chest.
41. Hæmophilia.
42. Chronic Laryngitis, Hoarseness.
43. Intestinal obstruction.
44. Gastric Ulcer (Operation).
45. Thrombosis.
46. Some innocent growth.
47. Exposure to Infection from Tuberculosis.
48. Skin Affection.
49. Instrumental Labour or Labours.
50. Hydrocele.
51. Operation for Peritonitis.
52. Ex-ophthalmia.

An examination of this schedule shows the very varied character of the risks included in this group, rendering a combined experience of the whole of very little use. But it will be seen that many of the Sub-groups may be roughly classed together, and accordingly it was decided to combine them into the following five sections.

Group E.—Schedule of Sections into which various Sub-groups were combined.

Group E.—Section I.

2. Not Robust, Poor Physique, Delicate, Anæmic-looking.
7. Fair or indifferent health.
30. Looks older.

Group E.—Section II.

1. Tuberculous Glands.
5. Hæmoptysis.

8. Tuberculous Bone Disease.
13. Lupus.
36. Incipient Phthisis in the past.
47. Exposure to the infection of Tuberculosis.

GROUP E.—SECTION III.

24. Gravel.
32. Albuminuria.
34. Nephritis.

GROUP E.—SECTION IV.

9. Chest Malformation.
11. Pleurisy, Pneumonia or Empyema.
15. Spinal Curvature.
16. Bronchitis.
17. Lungs unsatisfactory.
42. Chronic Laryngitis.

GROUP E.—SECTION V.

The remainder of the E cases made up of personal defects and disease, such as—

3. Dyspepsia.
4. Infantile Paralysis.
6. Nervous disposition.
10. Varicose Veins.
12. Hernia.

* * * * * * *

52. Ex-ophthalmia.

Insufficient Records of Albuminuria.

Even after this amalgamation it was found that Section III had to be discarded. This is much to be regretted, as it includes the important class of cases in which there is a personal history of albuminuria. For the other four Sections it was possible to investigate only the endowment assurance data on male lives.

With regard to these four sections generally, remembering that the Tables refer entirely to endowment assurances, it will be seen that the rates of mortality are high.

Poor Physique.

Beyond this there are, however, certain distinctive features in each section. Sections II and IV, dealing with blemishes of a tuberculous or pulmonary nature have already been discussed in connection with the general subject

of tuberculosis. In Section I the mortality, except in the early years of assurance, in which the rates are comparatively heavy, is not very different from the normal for endowment assurances. This would seem to indicate that persons of poor physique are not much inferior to normal risks provided they show no definite sign of impairment, and that in such cases only a temporary surcharge is required.

TABLE LII.

Group E. *Section* I.

Comparison of Actual Deaths with those Expected according to O[M] *Table.*

(A) *First* 10 *years of Assurance.*

Endowment Assurances. *Males.*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
37	57·0	51	**89·5**	58·2	61	**104·8**	115·2	112	**97·2**
38–52	17·9	19	**106·1**	21·1	16	**75·8**	39·0	35	**89·7**
Total	74·9	70	**93·5**	79·3	77	**97·1**	154·2	147	**95·3**

(B) *Ultimate Experience, excluding first* 10 *years of Assurance.*

Central Age Attained	Expected Deaths		Actual Deaths		Percentage
(1)	(2)		(3)		(4)
40	15·1	29·8	6	19	**63·8**
45	14·7		13		
50	12·7	22·1	6	15	**67·9**
55	9·4		9		
60	5·3	7·5	6	7	**93·3**
65	2·2		1		

Section V consists of risks of such varied character that little reliance can be placed on the combined results. The blemishes in some of the Sub-groups included in this Section are quite serious, and medical opinion as to their prognosis must remain the only guide in dealing with such cases. The results are given in Table LIII.

Table LIII.

Group E. *Section* V.

Comparison of Actual Deaths with those Expected according to O[M] *Table.*

(A) *First* 10 *years of Assurance.*

Endowment Assurances. *Males.*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	8)	(9)	(10)
–37	30·7	24	**78·2**	31·3	36	**115·0**	62·0	60	**96·8**
38–52	18·1	22	**121·5**	20·6	23	**111·7**	38·7	45	**116·3**
Total	48·8	46	**94·3**	51·9	59	**113·7**	100·7	105	**104·3**

(B) *Ultimate Experience, excluding first* 10 *years of Assurance.*

Central Age Attained	Expected Deaths		Actual Deaths		Percentage
(1)	(2)		(3)		(4)
40	8·2	17·4	8	16	**92·0**
45	9·2		8		
50	8·6	16·5	4	10	**60·6**
55	7·9		6		
60	6·9	9·6	5	7	**72·9**
65	2·7		2		

Formerly Intemperate.

In Group F were included those male lives who appeared, from an examination of the proposals and other reports, to have been formerly intemperate. This Group is naturally a small one, consisting altogether of 1,718 lives, and the whole-life and endowment assurances were combined in one Table.

Table LIV.

Group F.—*Formerly Intemperate.*

Comparison of Actual Deaths with those Expected according to O[M] *Table.*

(A) *First* 10 *years of Assurance.*

Whole-Life and Endowment Assurances. *Males.*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
–37	10·5	26	**247·6**	15·6	23	**147·4**	26·1	49	**187·7**
38–52	20·7	47	**227·1**	40·2	83	**206·5**	60·9	130	**213·5**
53–62	9·4	13	**138·3**	18·6	33	**177·4**	28·0	46	**164·3**
Total	40·6	86	**211·8**	74·4	139	**186·8**	115·0	225	**195·6**

(B) *Ultimate Experience, excluding first* 10 *years of Assurance.*

Central Age attained	Expected Deaths		Actual Deaths		Percentage
(1)	(2)		(3)		(4)
40	4·5	12·0	1	13	**108·3**
45	7·5		12		
50	11·4	28·6	19	33	**115·4**
55	17·2		14		
60	24·4	52·1	39	75	**143·9**
65	27·7		36		
70	19·1	28·3	34	44	**155·5**
75	9·2		10		

During the first 5 years of assurance, it will be seen that the mortality at the principal insuring ages is exceptionally bad, being the worst of any of the Groups investigated. During the second 5 years the mortality, though still excessive, shows a slight improvement, but in the Ultimate Table there is shown a consistently progressive increase with the age attained.

The opinion may safely be ventured that these figures show that where there is the least suspicion of former intemperance, the lives are undesirable as assurance risks.

Gouty Diathesis and Family History of Gout.

Group G deals with gouty diathesis and family history of gout. This Group consists entirely of male lives, and as the data were so few, the whole-life and endowment assurances were combined. The results are shown in Table LV.

Table LV.

Group G.—*Gouty Diathesis and Family History of Gout.*
Comparison of Actual Deaths with those Expected according to O^{M} *Table.*

(A) *First* 10 *years of Assurance.*

Whole-Life and Endowment Assurances. *Males.*

Ages at Entry	Years of Assurance								
	0–4			5–9			0–9		
	Expected Deaths	Actual Deaths	Per-centage	Expected Deaths	Actual Deaths	Per-centage	Actual Deaths	Expected Deaths	Per-centage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
–37	1·9	3	**157·9**	2·0	7	**350·0**	3·9	10	**256·4**
38–52	11·0	22	**200·0**	14·9	30	**201·3**	25·9	52	**200·8**
53–62	7·0	18	**257·1**	11·7	31	**265·0**	18·7	49	**262·0**
Total	19·9	43	**216·1**	28·6	68	**237·8**	48·5	111	**228·9**

(B) *Ultimate Experience, excluding first* 10 *years of Assurance.*

Central Age Attained	Expected Deaths		Actual Deaths		Percentage
(1)	(2)		(3)		(4)
40	·6	2·0	...	2	**100·0**
45	1·4		2		
50	3·1	9·6	5	16	**166·7**
55	6·5		11		
60	11·1	24·8	16	30	**121·0**
65	13·7		14		
70	13·6	23·5	16	29	**123·4**
75	9·9		13		

The mortality throughout is very heavy, but is lower in the first 5 years of assurance than in years of assurance 5 to 9. From the Ultimate Table it appears that the maximum of excess mortality is attained between ages 50 and 60.

On investigating the deaths in this Group we found a large number where the cause of death was cirrhosis of liver. This at least raises a suspicion that the assured persons in this Group were not all total abstainers.

Conclusion.

Value of the Results.

In concluding this Paper, we venture to express the hope that the results may be considered not merely of interest, but also of practical value. It appears to us that its main value lies in the investigation of the incidence of the extra risk in the various groups and classes dealt with. This incidence has been shown to vary not only in regard to age, but also in regard to duration of assurance. It has been shown to depend in large measure also on the self-selection of the assured as expressed by the class of policy chosen. We have deliberately abstained from making specific suggestions as to the methods of dealing with the extra risks, either by way of extra premiums, rating-up of age, or decreasing contingent debts, nor have we touched the equally important question of modification of reserves. These subjects form a separate branch of enquiry, and to have included them would have unduly extended the length of the Paper.

We have had the great advantage of being able to draw upon a very substantial body of data, and to treat it on a consistent plan under the supervision of a single medical officer fully conversant with the problems involved. These are almost ideal conditions. We venture to think that one of the results of the investigation should be to indicate the lines upon which further research can profitably be made, whether by individual offices or by collective action.

Many actuaries have made researches in the same subjects, but we have refrained from specific reference to their works, because it has been our aim to restrict the Paper within as reasonable bounds as possible. We hope, however, that the discussion which is to follow will throw further light on the many problems involved.

Finally, we would record our great indebtedness to Mr. G. A. Vokins, A.I.A., whose suggestions and enthusiastic help in dealing with the large amount of clerical work involved have been of the utmost value in the preparation of this Paper.

APPENDIX.

Aggregate Tables.

Family History of Tuberculosis. *Combined Experience* A_0 *to* A_{12}.

Whole-Life Assurances. *Males.*

Age next Birthday x	Full Aggregate		Excluding First 5 Years of Assurance		Excluding First 10 Years of Assurance	
	E_x	θ_x	$E_x^{(5)}$	$\theta_x^{(5)}$	$E_x^{(10)}$	$\theta_x^{(10)}$
20	14	...	...	...	...	...
21	38	...	...	...	...	...
22	87	2	2	...	...	...
23	141	1	2	...	...	...
24	223	1	4	...	...	...
25	301	4	17	...	...	...
26	416	3	46	1	3	1
27	534	3	83	1	3	1
28	660	8	137	3	6	...
29	830	1	193	...	9	...
30	970	8	275	3	23	...
31	1,171	13	379	4	46	1
32	1,348	14	515	5	90	...
33	1,541	12	621	6	137	2
34	1,738	13	772	7	191	2
35	1,936	20	920	8	265	3
36	2,129	16	1,109	8	340	3
37	2,318	22	1,265	12	453	5
38	2,508	29	1,450	12	557	4
39	2,646	24	1,624	15	667	4
40	2,796	36	1,784	22	789	13
41	2,890	29	1,933	17	928	6
42	2,971	29	2,037	22	1,046	11
43	3,095	29	2,129	22	1,161	16
44	3,189	36	2,216	26	1,302	17
45	3,283	38	2,299	25	1,424	12
46	3,349	38	2,373	29	1,521	21
47	3,401	42	2,384	31	1,563	21
48	3,452	41	2,448	29	1,605	20
49	3,430	51	2,484	39	1,645	22
50	3,348	49	2,453	37	1,639	24
51	3,218	63	2,444	48	1,628	31
52	3,067	40	2,423	37	1,627	29
53	2,909	36	2,383	28	1,624	19
54	2,729	38	2,321	31	1,591	19

Family History of Tuberculosis. Combined Experience A_0 *to* A_{12}. *—continued.*

Whole-Life Assurances. *Males.*

Age next Birthday x	Full Aggregate		Excluding First 5 Years of Assurance		Excluding First 10 Years of Assurance	
	E_x	θ_x	$E_x^{(5)}$	$\theta_x^{(5)}$	$E_x^{(10)}$	$\theta_x^{(10)}$
55	2,538	62	2,221	56	1,560	42
56	2,328	39	2,062	34	1,505	25
57	2,136	44	1,929	42	1,479	32
58	1,929	49	1,762	45	1,417	37
59	1,699	52	1,573	49	1,319	38
60	1,485	56	1,402	54	1,209	51
61	1,285	47	1,231	47	1,071	41
62	1,095	38	1,066	38	939	32
63	932	27	917	27	818	23
64	790	26	785	26	705	23
65	650	23	646	23	595	23
66	546	35	544	35	504	32
67	437	23	437	23	412	23
68	351	12	351	12	338	11
69	289	13	289	13	283	12
70	230	20	230	20	227	20
71	181	18	181	18	178	17
72	144	10	144	10	141	10
73	119	11	119	11	116	9
74	92	5	92	5	91	5
75	73	7	73	7	73	7
76	57	6	57	6	57	6
77	41	3	41	3	41	3
78	35	5	35	5	35	5
79	26	1	26	1	26	1
80	21	5	21	5	21	5
81	13	3	13	3	13	3
82	10	3	10	3	10	3
83	5	...	5	...	5	...
84	3	...	3	...	3	...
85	2	1	2	1	2	1
86	1	1	1	1	1	1

Family History of Tuberculosis. *Combined Experience* A_9 *to* A_{12}.

Endowment Assurances. *Males.*

Age next Birthday x	Full Aggregate		Excluding First 5 Years of Assurance		Excluding First 10 Years of Assurance	
	E_x	θ_x	$E_x^{(5)}$	$\theta_x^{(5)}$	$E_x^{(10)}$	$\theta_x^{(10)}$
16	3	...	...	...	...	...
17	5	...	...	...	...	...
18	34	...	...	...	...	...
19	161	2	...	...	...	...
20	806	1	...	...	...	...
21	2,608	11	3	...	...	...
22	4,828	19	9	...	...	...
23	6,632	20	68	...	...	...
24	8,261	33	208	1	...	...
25	9,959	41	679	3	...	...
26	11,454	54	1,786	5	3	...
27	12,899	56	3,122	12	11	...
28	14,172	55	4,282	21	62	...
29	15,141	67	5,321	28	180	1
30	16,053	61	6,363	31	480	3
31	16,744	71	7,206	33	980	2
32	17,289	86	8,026	52	1,582	9
33	17,552	80	8,637	47	2,038	16
34	17,655	84	9,159	46	2,475	12
35	17,729	92	9,739	46	2,972	15
36	17,497	91	10,081	55	3,344	18
37	17,273	86	10,280	57	3,688	21
38	16,829	100	10,273	57	3,957	23
39	16,284	88	10,203	57	4,197	24
40	15,537	86	9,853	54	4,171	25
41	14,734	87	9,565	62	4,261	25
42	13,965	70	9,267	55	4,320	22
43	13,210	89	8,970	68	4,336	31
44	12,377	96	8,571	74	4,268	43

Family History of Tuberculosis. *Combined Experience* A_0 *to* A_{12}. *—continued.*

Endowment Assurances. *Males.*

Age next Birthday x	Full Aggregate		Excluding First 5 Years of Assurance		Excluding First 10 Years of Assurance	
	E_x	θ_x	$E_x^{(5)}$	$\theta_x^{(5)}$	$E_x^{(10)}$	$\theta_x^{(10)}$
45	11,384	75	8,007	57	4,002	32
46	10,539	59	7,548	46	3,857	26
47	9,606	58	7,043	50	3,746	23
48	8,708	67	6,513	48	3,586	28
49	7,759	65	5,992	53	3,385	35
50	6,627	76	5,240	62	2,936	41
51	5,638	51	4,660	42	2,646	23
52	4,762	43	4,084	36	2,368	21
53	4,027	61	3,566	59	2,163	35
54	3,348	50	3,067	46	1,950	34
55	2,612	42	2,491	42	1,614	27
56	2,072	19	2,009	19	1,380	14
57	1,664	25	1,627	25	1,196	18
58	1,342	35	1,322	34	1,040	30
59	1,035	25	1,020	25	850	20
60	659	15	653	15	579	14
61	426	10	423	10	394	8
62	283	10	280	10	262	10
63	188	7	187	7	178	7
64	128	1	128	1	122	1
65	30	1	30	1	27	1
66	8	1	8	1	6	1
67	5	1	5	1	3	1
68	3	...	3	...	2	...
69	2	...	2	...	2	...
70	1	...	1	...	1	...
71	1	...	1	...	1	...
72	1	...	1	...	1	...
73	1	...	1	...	1	...
74	1	1	1	1	1	1

Personal History of Rheumatic Fever and Lesions of the Circulatory System.

Whole-Life Assurances. *Group* B. *Males.*

Age next Birthday x	Full Aggregate		Excluding First 5 Years of Assurance		Excluding First 10 Years of Assurance	
	E_x	θ_x	$E_x^{(5)}$	$\theta_x^{(5)}$	$E_x^{(10)}$	$\theta_x^{(10)}$
20	1	...	...	...	...	...
21	4	...	...	...	...	...
22	10	...	...	...	...	...
23	13	...	1	...	...	...
24	19	...	1	...	...	...
25	31	...	3	...	...	...
26	40	1	7	...	...	...
27	52	1	12	1	...	...
28	64	1	16	...	...	...
29	90	...	26	...	...	...
30	109	1	36	1	3	...
31	138	...	49	...	9	...
32	157	2	69	...	14	...
33	180	2	85	2	24	1
34	206	2	99	1	32	...
35	236	1	125	1	44	...
36	259	6	155	5	57	1
37	302	3	180	2	71	...
38	314	2	200	2	81	...
39	346	5	241	3	102	1
40	371	3	268	2	116	...
41	413	6	299	6	150	4
42	437	11	330	6	172	1
43	456	8	356	7	204	5
44	473	8	376	6	232	2
45	504	13	390	11	251	6
46	522	10	399	9	261	6
47	535	12	412	6	280	5
48	552	17	440	12	298	9
49	557	13	442	9	309	5
50	559	14	447	13	308	7
51	551	18	442	17	323	13
52	559	13	437	9	324	5
53	571	13	455	12	335	8
54	571	16	453	14	339	10
55	566	22	450	17	337	11
56	543	18	448	18	335	16
57	525	16	443	14	318	9
58	507	17	433	14	313	12
59	482	15	418	14	295	12

Personal History of Rheumatic Fever and Lesions of the Circulatory System.

Whole-Life Assurances. *Group* B.—*continued.* *Males.*

Age next Birthday x	Full Aggregate		Excluding First 5 Years of Assurance		Excluding First 10 Years of Assurance	
	E_x	θ_x	$E_x^{(5)}$	$\theta_x^{(5)}$	$E_x^{(10)}$	$\theta_x^{(10)}$
60	447	15	391	14	283	9
61	405	14	361	12	270	9
62	377	14	348	14	267	12
63	334	17	319	16	244	14
64	298	7	285	7	219	5
65	278	14	270	13	208	10
66	242	14	236	13	182	11
67	220	13	215	13	175	8
68	198	15	193	14	166	12
69	172	11	171	11	148	10
70	143	13	142	13	126	11
71	124	16	124	16	109	14
72	100	5	100	5	90	5
73	83	5	83	5	74	5
74	70	9	70	9	64	8
75	56	9	56	9	51	8
76	37	4	37	4	35	4
77	31	4	31	4	31	4
78	26	4	26	4	26	4
79	22	8	22	8	22	8
80	12	1	12	1	12	1
81	9	1	9	1	9	1
82	5	...	5	...	5	...
83	5	1	5	1	5	1
84	4	1	4	1	4	1
85	4	1	4	1	4	1
86	3	1	3	1	3	1
87	2	...	2	...	2	...
88	2	1	2	1	2	1
89	1	...	1	...	1	...
90	1	1	1	1	1	1

Personal History of Rheumatic Fever and Lesions of the Circulatory System.

Endowment Assurances. *Group* B. *Males.*

Age next Birthday x	Full Aggregate		Excluding First 5 Years of Assurance		Excluding First 10 Years of Assurance	
	E_x	θ_x	$E_x^{(5)}$	$\theta_x^{(5)}$	$E_x^{(10)}$	$\theta_x^{(10)}$
16	1	...	...	...	...	...
17	4	...	...	...	...	...
18	9	...	...	...	...	...
19	27	...	...	...	...	...
20	73	...	...	...	...	...
21	173	...	1	...	...	...
22	329	2	6	...	...	...
23	434	1	12	...	...	...
24	586	1	33	...	...	...
25	704	6	71	1	...	...
26	793	1	157	1	3	...
27	917	7	241	2	7	...
28	1,004	8	315	3	12	...
29	1,135	5	426	3	27	...
30	1,185	3	502	1	53	...
31	1,260	1	585	...	98	...
32	1,345	6	675	3	150	1
33	1,394	11	731	7	184	2
34	1,450	8	833	6	257	4
35	1,499	9	904	5	313	2
36	1,532	12	964	5	366	2
37	1,542	9	1,023	5	436	2
38	1,551	15	1,055	8	478	4
39	1,536	15	1,068	8	528	3
40	1,482	17	1,046	15	541	7
41	1,439	11	1,030	7	566	6
42	1,409	10	1,016	8	590	3
43	1,382	19	1,015	7	592	1
44	1,316	16	999	15	571	7
45	1,233	11	946	6	546	4
46	1,131	10	879	6	511	5
47	1,076	10	828	8	487	3
48	1,015	14	814	11	503	6
49	950	11	767	10	480	7

Personal History of Rheumatic Fever and Lesions of the Circulatory System.

Endowment Assurances. *Group* B.—*continued.* *Males.*

Age next Birthday x	Full Aggregate		Excluding First 5 Years of Assurance		Excluding First 10 Years of Assurance	
	E_x	θ_x	$E_x^{(5)}$	$\theta_x^{(5)}$	$E_x^{(10)}$	$\theta_x^{(10)}$
50	837	18	638	15	395	6
51	745	13	584	11	362	8
52	660	10	540	9	325	5
53	585	9	477	7	308	6
54	509	9	435	9	286	6
55	419	11	374	11	228	5
56	367	6	334	5	214	3
57	325	4	300	4	206	1
58	286	15	266	14	187	9
59	232	6	223	6	162	5
60	163	6	156	6	119	5
61	113	5	111	5	85	4
62	87	3	86	3	66	...
63	62	2	62	2	52	2
64	41	1	41	1	36	...
65	13	1	13	1	11	...
66	5	...	5	...	5	...
67	2	...	2	...	2	...
68	2	...	2	...	2	...
69	2	...	2	...	2	...
70	2	...	2	...	2	...
71	1	...	1	...	1	...
72	1	...	1	...	1	...
73	1	...	1	...	1	...
74	1	...	1	...	1	...
75	1	...	1	...	1	...
76	1	...	1	...	1	...

Obesity.

Whole-Life Assurances. *Group* D. *Males.*

Age next Birthday x	Full Aggregate		Excluding First 5 Years of Assurance		Excluding First 10 Years of Assurance	
	E_x	θ_x	$E_x^{(5)}$	$\theta_x^{(5)}$	$E_x^{(10)}$	$\theta_x^{(10)}$
21	1	1	...	...	...	...
22	1	...	...	...	...	...
23	2	...	...	...	...	...
24	4	...	...	...	...	...
25	4	...	...	...	...	...
26	5	...	...	...	...	...
27	11	...	1	...	...	...
28	18	...	1	...	...	...
29	21	...	2	...	...	...
30	31	...	3	...	...	...
31	44	...	5	...	...	...
32	53	1	8	...	...	...
33	68	1	11	...	...	...
34	78	1	14	...	...	...
35	92	1	23	...	1	...
36	111	...	33	...	2	...
37	131	1	36	1	5	...
38	142	1	40	...	5	...
39	150	1	47	1	9	1
40	178	5	59	2	15	1
41	191	1	59	...	17	...
42	227	6	77	3	19	2
43	239	3	76	1	20	...
44	271	4	89	1	25	...
45	313	9	103	6	29	2
46	369	3	119	2	34	...
47	422	5	136	2	40	...
48	466	15	152	6	45	2
49	498	8	182	4	48	2
50	536	20	211	15	57	3
51	573	10	235	8	68	4
52	611	23	258	11	69	2
53	617	16	268	10	83	3
54	635	14	279	10	94	5

Obesity.

Whole-Life Assurances. *Group* D.—*continued.* *Males.*

Age next Birthday x	Full Aggregate		Excluding First 5 Years of Assurance		Excluding First 10 Years of Assurance	
	E_x	θ_x	$E_x^{(5)}$	$\theta_x^{(5)}$	$E_x^{(10)}$	$\theta_x^{(10)}$
55	653	16	304	9	98	2
56	640	19	322	9	98	2
57	624	19	334	15	109	10
58	590	25	337	13	116	4
59	546	26	330	17	116	7
60	493	15	311	10	112	5
61	449	18	300	15	125	9
62	402	16	289	11	123	2
63	343	21	262	16	114	7
64	296	11	250	11	115	5
65	254	15	230	14	114	4
66	199	15	192	15	108	7
67	160	18	156	18	101	14
68	124	8	123	8	82	5
69	98	8	98	8	74	6
70	79	8	79	8	64	8
71	61	7	61	7	57	7
72	47	8	47	8	45	7
73	32	4	32	4	32	4
74	23	1	23	1	23	1
75	20	4	20	4	20	4
76	14	3	14	3	14	3
77	8	1	8	1	8	1
78	6	2	6	2	6	2
79	4	1	4	1	4	1
80	3	...	3	...	3	...
81	3	...	3	...	3	...
82	1	...	1	...	1	...
83	1	...	1	...	1	...
84	1	1	1	1	1	1

Obesity.

Endowment Assurances. *Group* D. *Males.*

Age next Birthday x	Full Aggregate		Excluding First 5 Years of Assurance		Excluding First 10 Years of Assurance	
	E_x	θ_x	$E_x^{(5)}$	$\theta_x^{(5)}$	$E_x^{(10)}$	$\theta_x^{(10)}$
18	1	...	...	...	...	...
19	5	...	...	...	...	...
20	14	...	...	...	...	...
21	23	...	1	...	...	...
22	38	...	1	...	...	...
23	56	...	2	...	...	...
24	80	1	3	...	...	...
25	109	1	8	...	...	...
26	157	2	11	...	1	...
27	176	...	22	...	1	...
28	226	...	32	...	2	...
29	301	1	49	...	3	...
30	381	...	65	...	5	...
31	437	3	93	1	5	...
32	483	2	112	...	14	...
33	542	4	137	2	13	...
34	600	5	178	2	19	...
35	671	4	217	...	22	...
36	724	2	247	1	35	...
37	763	3	270	3	38	...
38	816	6	296	2	52	1
39	849	11	321	4	56	1
40	913	4	355	2	70	...
41	936	13	380	11	76	2
42	943	11	378	5	73	2
43	937	8	402	3	81	...
44	933	7	414	6	99	2
45	920	14	424	8	95	1
46	883	8	425	3	94	1
47	865	15	439	11	92	1
48	827	10	430	6	94	1
49	789	11	429	9	119	3

Obesity.

Endowment Assurances. *Group* D.—*continued.* *Males.*

Age next Birthday x	Full Aggregate		Excluding First 5 Years of Assurance		Excluding First 10 Years of Assurance	
	E_x	θ	$E_x^{(5)}$	$\theta_x^{(5)}$	$E_x^{(10)}$	$\theta_x^{(10)}$
50	782	13	406	11	118	4
51	718	16	388	12	114	2
52	627	16	360	12	114	6
53	556	12	364	9	121	4
54	496	15	344	12	111	5
55	396	16	311	15	98	10
56	335	11	267	10	85	4
57	286	8	237	7	82	3
58	231	6	199	6	90	1
59	193	6	169	5	83	1
60	132	10	116	10	71	7
61	89	4	86	4	51	2
62	46	3	46	3	26	1
63	30	3	30	3	17	1
64	20	3	20	3	15	2
65	11	3	11	3	7	2
66	3	1	3	1	3	1
67	1	...	1	...	1	...