THE AMERICAN EXPERIENCE TABLE OF MORTALITY.

(S. A. Joffe before the Actuarial Society of America.)

(Continued from page 613.)

THE MUTUAL'S ACTUARY.

On the death of Professor Gill the Mutual engaged as actuary, in the beginning of 1856, Sheppard Homans, a young mathematician-astronomer, under twenty-five years of age, who, prior to his appointment, according to Mr. Fackler, "did not know what the word 'premium' meant." Notwithstanding that, after a brief interval of two years, Homans made a remarkable actuarial investigation of the fifteen years' mortality experience of the Mutual, and the results of this extraordinary work are embodied in his "Report Exhibiting the Experience of the Mutual Life Insurance Company of New York for Fifteen Years ending February 1st, 1858," published by the company in November, 1858.

As a result of his investigation of the fifteen years' experience, Homans constructed an adjusted table of mortality, known as Homans' Table No. 1.

In this table no figures are given for the rate of mortality or for its reciprocal above the age 74. At the same time, the numbers of living and dying are stated for each quinquennial age to 99 inclusive. I find that these were computed by assuming the rate of mortality qx of the 17 Offices' Table, beginning with age 74, and by computing dx from lx and qx by multiplication. However, for the rest of the table, I regret to state, the methods employed by Homans in passing from the unadjusted values to the adjusted rates of mortality have so far not been ascertained by me. All my efforts to reproduce the reciprocal rx of the rate of mortality qx of Table No. 1 have proved futile, although this reciprocal seems to be, with Homans as well as with Gill, the primary function from which lx and dx are computed.

It remains now to establish the connection between this Table No. 1 and Homans' Table No. 2, the "American Experience Table," and with that purpose in view I wish to call attention to the following historical facts regarding the Mutual's survivorship annuity rates of 1862.

Mr. Fackler points out that the Mutual's premium rates for survivorship annuities, published in the company's rate book for 1862, are based on the American Experience Table, and quotes a few lines from that rate book which show that the Table was approved by certain English actuaries in the spring of 1861, when Homans visited England. The lines quoted by Mr. Fackler from the company's 1862 rate book also appear in the nineteenth annual report of the Mutual, published early in 1862, of which pages 17 and 18 are devoted to the subject of survivorship annuities.

The text in the report commences as follows: "The officers of this company have long had under consideration the propriety of offering to the public rates of premium by which survivorship annuities, at all combinations of ages, may be secured," and, after describing the peculiar features of a survivorship annuity, it continues: "We have now the satisfaction of making public these rates of premiums, as will be seen by reference to the tables on the following pages," and ends with the statement, already quoted by Mr. Fackler, that "These rates of premium have been calculated at great labor, and upon an entirely new and original basis, which has been submitted to, and received the unanimous approval of some of the most experienced and able managers and actuaries in Great Britain, as well as of some of the leading insurance officials in this country."

SURVIVORSHIP ANNUITIES.

In the company's eighteenth annual report, issued one year earlier, *i.e.*, in 1861, on page 25, we find the following: "Policies will be issued as soon as the tables now in preparation are completed, payable on the death of the party assured to a wife, child, or other nominee, in the form of an annuity, in annual, semi-annual or quarterly payments, at all combinations of ages." Although there is no reference whatever to survivorship annuities in the seventeenth report, we find a part of pages 27 and 28 of the sixteenth report devoted to such annuities, and finally, the fifteenth report (issued early in 1858) contains the following important reference to the subject: "The arrangement of proper tables for the issue of Post obit Annuities in connection with our policies, recently authorized by the board, is receiving the attention of the Office, and they will be prepared and submitted as soon as practicable."

From this it appears that in the same year, 1858, in which Homans produced his fifteen years' experience report, he was instructed to prepare tables of rates for survivorship annuities. Under the circumstances it was only natural for him to turn to his own "Adjusted Table of Mortality" as a table on which to base the desired survivorship annuity rates. But we can easily understand the difficulties he encountered in his endeavors. Although Homans' Table No. 1 was an adjusted table, one glance at the irregular curve representing rx of this table will be sufficient to show how imperfect its graduation was.

It must then have occurred to him to apply to his Table No. 1 the same process of "smoothing out" as had been applied to the Carlisle Table by Gill, in modifying it for the purpose of calculating the premium rates of 1853. Indeed, on computing the values of rx, *i.e.*, $\frac{lx}{dx}$ of the American Experience Table, and constructing the corresponding curve, I find that it is not only a strikingly regular curve, but it is clearly a smoothing out of Homan's curve of 1858. And it may be stated with the utmost emphasis that this curve (of the American Experience Table) is so regular and looks so much like a "free hand" drawing, smoothing out Homans' first curve, that I do not see any necessity for introducing the assumption that the American Experience Table was based on the mortality experience of years succeeding 1858.

Of course, there still remains the old question, "On what did Homans base his figures for the higher ages?" and especially the mooted question, "Why did Homans take age 95 as the limiting age?" But inasmuch as in 1858 the oldest policyholder was then only 78 years old, a few more years of new business or additional "exposure" could not produce a single insured of such an advanced age as to furnish information for the limiting age. It may help us to clear up this point if we read the following few lines from the seventeenth annual report of the Mutual, published early in 1860, page 12: "In middle age