TRANSACTIONS

OF THE

FACULTY OF ACTUARIES

William Morgan, F.R.S., 1750-1833.

A LECTURE BY

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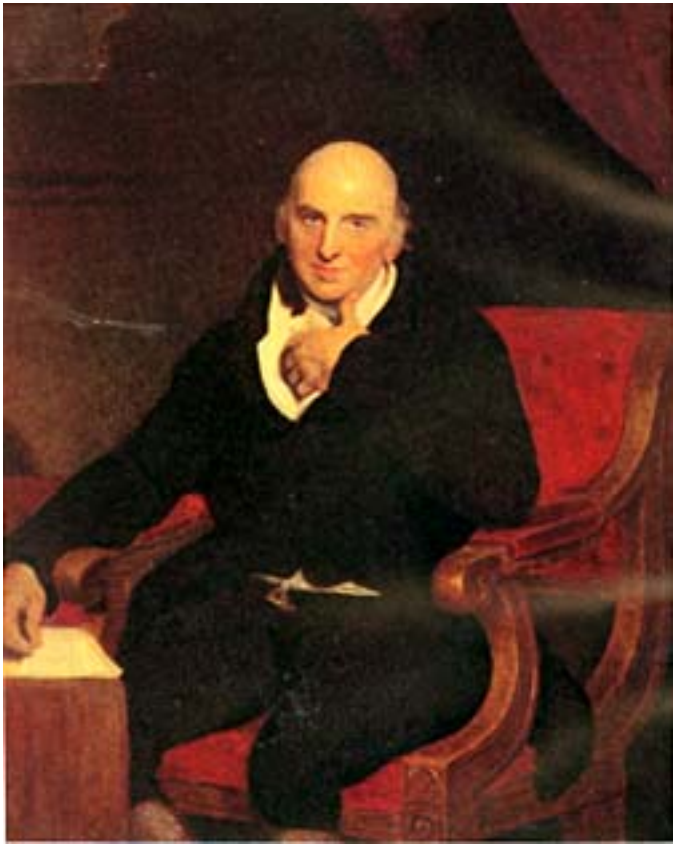
WILLIAM MORGAN was born on the 26th May 1750 at Bridgend, where his father was a doctor; he was the eldest son, and with a view to continuing his father's practice arrangements were made for him to study in London, where he spent a few years, staying for a part of the time with Dr. Richard Price*, his mother's brother. Apparently Morgan's father had begun to find that he could not continue his practice single-handed after the retirement of his partner, and wanted his eldest son to join him, although he thought that his son had more inclination for "academical learning than "for the study of pharmacy."

Unfortunately the father could not afford to place William Morgan as a pupil to a physician, and the boy, finding difficulties in pursuing his studies, engaged himself to an apothecary at Limehouse Docks. Work as an apothecary's assistant, combined with attendance at a hospital, would probably have meant a somewhat strenuous existence in any circumstances, but as his master was a disagreeable creature, and as the assistant had to sleep under the counter, the life became unbearable. Morgan's account of the final breach is as follows:—

"Went to Mr. Smith at Limehouse July 11th 1769. Left him "October 11th in a pet at my quarter's end." And he also said:— "My Welsh temper could stand it no longer; I turned upon him "and laid him in the kennel."

Richard Price found him a better employer afterwards in Mr. Bradney of Cannon Street, and he stayed there till nearly the end

* Richard Price, D.D., F.R.S., 1723-1791. See pedigree appended.



of his medical studies. Apparently he was thought well of by those under whom he studied, and after his father's death in 1772 he made an attempt to carry out the wish that he should succeed to the practice at Bridgend. The difficulties of the position were, however, considerable. His youth, in the opinion of his father's old friends, was against him, and he had a physical defect (a club foot) which was an objection in the eyes of some of his patients. Besides this, he found a competitor in Jenkin Williams, and when his sister married this rival, Morgan gave up the attempt to practise medicine in Bridgend and went to London to seek the advice of his uncle.

About this time Price had become known in financial matters, and his advice was sought on various subjects. Amongst others who had consulted him was the Society for Equitable Assurances, and when Morgan came to his uncle's house in 1773 it happened that John Edwards, who was then "actuary" to the Society, was dying. When Price returned from a visit to the Society's office, he asked his nephew if he knew mathematics. "No, uncle," was the reply, "but I can learn." And in a very short time he made himself sufficiently proficient and was appointed Assistant Actuary in February 1774, and a year later Actuary to the Society.

It may be of interest to record that his remuneration consisted of a house in Chatham Place, Blackfriars, at the Society's offices and a salary of £120 a year. A sister kept house for him until his marriage in 1781 to Susanna Woodhouse, by whom he had four sons and a daughter. One of the sons, William, acted as his assistant actuary at the Equitable for a few years, until the son's early death in 1819 put an end to the father's hopes that this son would succeed him. At a later date his youngest son, Arthur, who had been born in 1801, became assistant actuary, then joint actuary, and when William Morgan retired in 1830, actuary of the Equitable, with an inheritance of his father's pertinacity and an appreciable part of his father's ability. Father and son were actuary to the Equitable for over ninety-five years.*

In addition to William Morgan's business and scientific activities, he wrote, between 1793 and 1803, six pamphlets on public finance, displaying a strong dislike to the Pitt administrations and, in places, somewhat unrestrained criticism. In common, however, with his

* Many years after William Morgan's death his grandson, another William Morgan, familiarly known to his then colleagues as "Bob" Morgan, became assistant actuary. There are confusing references to "Morgan W" in the Index to *J.I.A.* These refer to W. Morgan, 1750-1833; to Arthur Morgan, 1801-1870; and one to a contribution in 1865 by "Bob" Morgan, 1831-1897.

other writings, they contain passages in which common-sense views are expressed vigorously. It may have been partly due to affection for one who had helped and befriended him that Morgan supported so strongly Richard Price's views on public finance, but he must have shared his uncle's political sympathies in full measure, because when he left Chatham Place in 1787 or 1788 to live at Stamford Hill his house became a meeting-place for the more advanced reformers such as Horne Tooke, Francis Burdett and Tom Paine. It is said that Morgan was suspected by the authorities and that, about the time of the acquittal of Horne Tooke, he was on the list of those threatened with prosecution. I find it hard to be interested in these old political passions and controversies; I derive more pleasure from the thought that Morgan's loyalty to his uncle's memory led him to edit not only Price's book on Reversionary Payments, but also a volume of his sermons, while in 1815 he published a Memoir of Price. This last book is, I regret to say, a rather poor piece of biography, but it shows Price as a man of broad views, many interests and wide sympathy—a man, moreover, of sufficient power to draw replies from Burke and Samuel Johnson—so that it is easy to understand the affection and admiration Price won from, and the predominating influence he exercised over, his nephew in early manhood. The book gives a glimpse of the circle in which Morgan moved; among Morgan's intimate friends was Samuel Rogers,* the poet, whose beautiful niece (Maria Towgood) married Morgan's son William.

It is interesting to notice that Morgan's first paper to the Royal Society in 1785 had no connection with life contingencies: it gave an account of a couple of electrical experiments "made to ascer- "tain the non-conducting power of a perfect vacuum." A few years

* During Theodore Hook's editorship of the Tory weekly, *John Bull*, Rogers was an object of personal attack. The following stanzas appeared 7th March 1824, and refer to Rogers' appearance: he was very pale and bald (see *Rogers and His Contemporaries*, by P. W. Clayden. London, 1889, vol. ii. p. 132).

HUMAN LIFE.

Cries Sam, "All human life is frail,
E'en mine may not endure;
Then, lest it suddenly should fail,
I 'll hasten to insure."

At Morgan's office Sam arrived,
Reckoning without his host;
"Avant!" the frightened Morgan cried,
"I can't insure a ghost."

"Zounds! 'tis my poem, not my face;
Here, list while I recite it."
Said Morgan, "Seek some other place,
I cannot underwrite it."

before (1781) he had published an examination of Dr. Crawford's theory of heat and combustion, and these two efforts indicate an interest in science outside Morgan's immediate work, though I do not imagine that either publication would count for much nowadays.

The portrait of Morgan by Lawrence* gives an idea of him when he was nearly seventy: think of the man in that portrait as a good conversationalist with a keen memory and a caustic wit, and as one having the gift of expressing himself clearly and forcibly in his writings. Perhaps his literary ability went further than this; it is said that when already old he still remembered the Welsh language, and once showed his skill by turning a Welsh song into elegant English verse on the spur of the moment. Another side of Morgan's character can be indicated by a story that is worth putting on record. On one occasion the Directors of the Equitable had a disagreement with their actuary, and neither party would give way: so the actuary retired to a stronghold in Wales with his books and papers until his Directors came to a better mind. He knew that the Directors would not dare to go to a general meeting and suggest that a successor to Morgan would have to be appointed; and in those days the General Court (General Meeting) elected the actuary!

Morgan bade farewell to the Equitable on the 2nd December 1830, after over fifty-six years' service, and he died on 2nd May 1833. I have told you the terms of his appointment: he was retired on his full salary of £2000 a year—a big figure for those days.

I hope what I have said may give you some idea of Morgan as a man. Let us now look at his actuarial work: I think that it too may add something to the impression.

His claim to be remembered by us rests on his ability in manag ing a life assurance company without any example or tradition to follow, and on his efforts to advance the study of life contingencies, especially perhaps in relation to survivorships, then an almost unknown subject.

In order to place this work in proper perspective, we must remember that little had then been done to study the methods by which annuities, premiums and reserves should be calculated, so that Morgan had to build up his science as he went. He was dealing with a new thing. Less than twenty years before he became actuary of the Equitable, it had been impossible to obtain a charter to enable life assurance to be carried on because the excessive

* The original, painted in 1818, is in the possession of the Equitable Life Assurance Society, with whose consent it is now reproduced. For the successful reproduction I am indebted to W. F. Sedgwick Ltd.

premiums then suggested were not sufficiently high, in the opinion of the Attorney-General, while the idea of charging premiums depending on the age seems to have been considered rather as a danger than as an unnecessary refinement.*

In 1779 Morgan published his *Doctrine of Annuities and Assurances*, with an introduction and an essay by Price. The solutions, so far as single lives are concerned, are correct and applicable to any table of mortality, though the explanations were given in terms of a hypothetical mortality table in which the number living (l_x) decreases by unity at each age till it ceases at 86 (De Moivre's Hypothesis). The solutions of the more complicated problems are exact with the hypothetical table, but, as Morgan points out, only approximate with other tables.

Morgan's next step, therefore, was to solve problems when more than one life was involved, in such a way that the real probabilities of life could be used in the calculations, and on 8th May 1788 he read a paper before the Royal Society in which he discussed the methods by which the premiums for survivorship assurances should be calculated, and gave tables showing the values by the Northampton table and the Swedish table, compared with approximations then in use. Further papers were read in 1789, 1791, 1794 and 1800, in which Morgan gave solutions of further problems and additional tables of numerical values. A few of the solutions were erroneous and others were clumsy, but the clumsiness arises because Morgan had not the advantage of seeing how the differential and integral calculus could be applied to the solution of his problems; and his errors are sometimes traceable to the difficulty of estimating properly those odds and ends of adjustments which have to be made when a writer assumes an even distribution of deaths in the year of death. Some of the solutions with much other matter were republished in the 1821 edition of the book on Assurances. The second edition, however, differed so much from the first that it was practically a new work.

Morgan was awarded the Copley Medal in 1789 and elected a Fellow of the Royal Society in 1790. His work may now seem to us insufficient to justify these honours, but it was the first serious attempt to obtain a general solution to the problems of survivor-

* Morgan's predecessors as "actuaries" of the Equitable were Mosdell, who died December 1764; Dodson, son of the mathematician, "but without the "mathematical learning of his father": he resigned April 1767; John Edwards, who kept the accounts well but did little of importance except that he consulted Price; and, after Edwards' death in December 1773, Pocock became actuary for about a year.

ship, and had the merit—a great one indeed—of giving expressions that could be used to obtain arithmetical results from any mortality table.

At the beginning of the nineteenth century Francis Baily indulged in a criticism of much of Morgan's work in such a way as to lead the reader to feel that some personal animosity was involved. The source of the animosity may have been the refusal by the Royal Society to publish the information * furnished by Baily as to Barrett's commutation columns. Baily thought that this was unjust to Barrett, and possibly attributed the refusal to Morgan, who was at the time on the Council of the Royal Society. Modern practice has accepted a certain amount of Baily's work and has adopted the commutation columns he praises: but it is worth noticing that Morgan has worked out extensive tables for the use of his own office by various methods, and that Baily did not improve Morgan's solutions of survivorship problems sufficiently to eliminate the fundamental weakness resulting from the assumption at some point in the calculations of an even distribution of deaths during the year.

We may pause here to point out that in his book on Assurances Morgan follows his uncle, Dr. Price, in the attempt the latter made in his *Reversionary Payments* to express all the algebraic results in a verbal form. This had the advantage that even a non-mathematical reader might be able to work out arithmetical results, but it makes troublesome reading nowadays, especially as it is combined with the old-fashioned arrangement of the matter in Problems and Lemmas, and an unaccustomed and uncomfortable notation. In consequence, partly, of all this, we feel depressed by a lack of elegance in his pioneer theoretical work, but, after all, Morgan set out to find arithmetical solutions to complicated problems that had arisen or might arise in practical work, and he found them.

Morgan also did work for Friendly Societies, basing his calculations on the Northampton table and on Price's more or less arbitrary rules about sickness or a modification of them (see Price's *Reversionary Payments*, 1812, vol. ii. p. 475). In the absence of data he had no intention of using anything else, but he refers in the

* Was the refusal because Tetens had discussed and published commutation columns in 1785 ? Tetens refers to Price's and Morgan's work, so that it would not be improbable that he sent them a copy of his. See F. Hendriks, *J.I.A.*, i. pp. 1 *et seq.* Morgan had, in effect, used a commutation column in Ch. II. of his *Annuities and Assurances*, 1779, but did not develop the theory. De Morgan's comments (*J.I.A.*, iv. pp. 185 *et seq.*) are interesting but seem to be based on conjecture.

evidence before the Committee of the House of Commons on Friendly Societies, in 1825 and 1827,* to " the account I have had, from a " gentleman in Scotland, of a great number of parishes for a number " of years," so that presumably he examined data which he thought suitable. His evidence is that some of the tables used by Friendly Societies are " exceedingly wrong," that the " alehouse " formation and expenditure was bad, and that lots of societies failed from sheer bad management. He gives a case of one society that spent £80 on dinners in a year. I gather from his evidence that he regarded such defects as of more importance than the tables of mortality and sickness.

References to Morgan will also be found in old text-books on Friendly Societies, but it is difficult to trace enough of this evidence to piece together a coherent account of this work.

He seems to have been widely consulted on all sorts of actuarial questions †—inevitably so: he was to all intents and purposes the only " actuary " available for many years, and when, in the nineteenth century, others could have been consulted, it may well have been thought that they possessed neither his experience nor his personality nor his prestige.

We may now turn to the work which Morgan did as the actuary of a life assurance office, and here we have plenty of information in the addresses Morgan delivered from time to time to the members of the Equitable Society.

The first address was in March 1793, after he had been connected with the Society for nearly twenty years, and was made because the funds of the Society (capital, as he always called it) had been accumulating rapidly, and he felt he ought to warn the members against being " misled by this accumulation into an ex- " travagant opinion respecting the circumstances of the Society." Possibly the real cause of this address was that he had completed a valuation which had been ordered to be made by the " General " Court " (General Meeting) after they had decided to have a substantial bonus without a valuation. This indicates Morgan's difficulties: practically no one with whom he had to deal appreciated the necessity of making valuations of the insurances that had been

* In 1817 he gave some opinions, to a House of Commons Committee on the Poor Laws, on allowances for children. I find difficulty in following either the questions asked or the answers he and Baily gave. The arithmetical answers of Morgan and Baily are impossibly different.

† It is pleasant to remember that Morgan was helpful in the early stages of the formation of the Scottish Widows' Fund. See J. M'Kean's "Address," published 1829. The copy I have consulted was presented to " William Morgan, " Esq., F.R.S., with most respectful compts from John M'Kean, Manager."

granted, and he set to work to convince the members of his own Society and the world in general why reserves are wanted and how they should be calculated. In order to explain the error of judging profits by looking only at the amount of funds, Morgan set out those first principles, now so familiar to us, in the form of an example of 1000 persons entering at age 30. He went on to mention some of the sources of profit; and, after referring to profits made in the past on expired term insurances and lapsed life assurances, of which there had been many, he drew attention to selection as a source of profit and said that " the probabilities of life among the " members have been considerably higher than in the table from " which the premiums are computed; and while the same care " is used in admitting none but *good* lives to be assured, there can " be no doubt of their continuing to do so."

There was no loading profit, as an unloaded Northampton 3 per cent. premium was charged; but Morgan points out that an insurance office must have a margin in mortality to cover the expenses for which there is no direct allowance in the premium. This method was suitable. Many of the initial expenses were met by a single payment made by the assured, and the expenses were less than 2 per cent. of the premium revenue during his administration. He had another incidental profit, because during the first twenty years of the Society's existence higher premiums had been charged, and although these premiums had been reduced subsequently, they helped to create a substantial surplus.

In other addresses and some of his writings Morgan refers to the profit made from the higher rate of interest obtained on investments than that assumed in calculating the premiums, so that he had appreciated fully the possible sources of profit in a life assurance fund.

In 1800, after making another valuation, he took the opportunity of advocating the adoption of three by-laws, providing (1) that valuations should be made once in every ten years, (2) that no bonus should be given without a valuation, and (3) that the value of new additions should not exceed two-thirds of the clear surplus.

Morgan's remarks about the new by-laws were in general terms, and do not tell us why he fixed two-thirds as the portion of surplus to be divided. He may have made some sort of " bonus reserve " valuation," possibly a very rough one, but I cannot believe that he guessed the figure. A mere guess would have been foreign to his other doings of which we have record, but if you prefer to think that he arrived at the proportion by intuition you are, perhaps, only paying a tribute, different from mine, to his memory.

Let us try to solve the problem ourselves. The data are Premiums Northampton 3 per cent. Valuation by same table. Decennial Reversionary Bonus (for unit assurance n years in force) rn where r is the rate allowed. This system gives heavy bonuses to policies many years in force. Notice that, possibly by good fortune,* the bonus system fits the premiums which are relatively high at the young and low at the older ages.

Now, though Morgan usually valued sums assured and bonuses, and then deducted the values of the premiums, he was also prepared to regard policy-values in terms of the premiums, and it would have been a small step to assume that the premiums at each age would, with the incidental profits to which he drew attention, provide the bonuses that were declared. Writing the policy-value in its usual form, A_{x+n} represents the value of an assurance by N. 3 per cent., or the single office premium for a new assurance which would produce future bonuses like any other new assurance. The deduction $P_x(1+a_{x+n})$ is the present value of the office premium by N. 3 per cent., or, if you prefer, by the Equitable experience with interest at a higher rate.† Morgan therefore had a bonus reserve valuation for part of the bonus; to complete the reserve it was necessary to compare the value, B, of a bonus of nr at the end of 10 years, *plus* like sums at the end of 20 years, 30 years, etc., with $nr\ A_{x+n}$ the cost of the new bonus. This comparison should not be by N. 3 per cent., and it seems probable that, if he did the arithmetical work, he would have used N. 4 per cent.‡ The com-

* My colleague, M. E. Ogborn, however suggests—

1. that the bonus system was devised as an approximation to the division of surplus in proportion to reserve, *i.e.* to the stake in the Society, which Morgan regarded as fair (see *Rise and Progress of Equitable*, pp. 57-9);
2. that as the earned interest had generally exceeded 5 per cent., the chief source of profit was interest, and this method of division was so far fair; and there was little objection to the division of lapse profit in the same way;
3. that this approximation to a contribution method helps to account for the bonus system fitting the premiums so well.

A most interesting line of thought.

† Morgan draws attention to the fact that variations in mortality and variations in interest may come to the same thing. (Friendly Societies evidence.)

‡ Morgan used Northampton table freely. I have found calculations by him at 4 per cent., and the examples he gives in his addresses and in the *Rise and Progress of Equitable* generally use it. I have ignored interim bonuses. They were not given at the time the rule was devised. Even when they were started in 1810 they were given in the form of r for each year since the previous valuation (with an adjustment at early duration), so that it would be permissible to assume that they were allowed for in the office single premium used for valuing the sum assured at the attained age.

putation—how he loved that word—is easy. He may have worked it out for the actual distribution of the business, because he sometimes discussed how the age distribution would be changed in future years, or he may merely have examined a few ages. I find the following results :—

Age.	Rough proportion of cases in Equitable business 1800.	Average duration in force.	Existing bonus at valuation.	New bonus on 1% basis.	Cost of new bonus N. 3%.	Value by N. 4%.	
						New bonus.	Future bonus not allowed for in the N. 3% val^{n}.
25	5	3	—	·15	·068	·055	·082
35	20	5	·2	1·00	·507	·421	·550
45	34	7	2·0	2·38	1·361	1·164	1·223
55	24	10	4·6	2·40	1·550	1·366	1·054
65	13	16	6·4	2·08	1·516	1·379	·647
75	4	22	3·3	·88	·729	·678	·117
	100		16·5	8·89	5·731	5·063	3·673

The rule being that two-thirds of the surplus was to be divided, the surplus corresponding to a cost of 5·731 would have been 8·597. The value of the new and unallowed-for future bonus both by N. 4 per cent. is 8·736.

But he had something else to bring things even nearer, because existing bonus might properly have been valued at N. 4 per cent. ; moreover, as the business grows older the rule becomes safer, as can be seen by examining the details of the table.

Another elementary method is to take age 35 at entry and examine the position at successive bonus distributions for a sum assured of £1000.

Years in force.	New bonus.	Value of new bonus N. 3%.	One and a half times value of new bonus.	Value by N. 4%.		
				New bonus.	Future bonus not allowed for.	Together.
10	100	57	86	49	51	100
20	200	129	194	98	103	201
30	300	219	329	171	132	303
40	400	328	492	265	124	389

There is again a margin in the value of existing bonuses sufficient to put the rule on the safe side at duration 20 ; even without that,

the rule gives a good approximation which is all that can be expected of it. Many years after Morgan's death, when interest rates had fallen, the rule did not work perfectly, but Morgan is hardly to blame if his successors applied it rigidly in altered conditions.

But you will appreciate that I have made his problem appear easier than it really was. Up to 1800 bonuses had not been declared at regular intervals, and the fact that at the same moment as he fixed the two-thirds rule he also fixed a ten-years interval for his distribution, suggests that he must have made calculations before coming to his decision. To us a fixed period for bonus distribution seems natural: to him it was a novelty.

When considering Morgan's valuation work—or, for that matter, when you are thinking of the history of the net premium valuation—you must remember that the valuation he made was a N. 3 per cent. net premium valuation; that it was, at the same time, a N. 3 per cent. gross premium valuation; and that it was also what used to be called the "hypothetical or reassurance" method of valuation.* The valuation was consistent with the premiums, and certain problems that arise to-day were obscured by the simpler valuation to which Morgan adhered wisely, but obstinately, in spite of criticism.

We now come to an interesting episode in Morgan's actuarial career. In 1816 he proposed to limit the number of members sharing in the profits of the Equitable Society to 5000, so that when that number was reached a new entrant had to wait for bonuses till an old member died or surrendered his assurance or let it lapse. Morgan's fear was that the Society was growing too big: he was afraid of "all the difficulties and dangers arising from the over-"growing number of members," and thought that many profits that had accrued in the past would be much reduced. He remarks that "a variety of computations . . . might be added to show "the utter impossibility of persevering in the present indiscriminate "admission of the public to a proportionate share of the Society's "surplus, without either lessening the future additions on the "one hand, or increasing the annual premiums on the other." Morgan saw interest rates falling: the old lapse profit at an end; and turning his conclusions into modern language, he did not see how the premiums charged could earn the old bonus, and an increasing membership made the position worse. Beside all this,

* See G. King's *Textbook on Life Contingencies*, pp. 327, 328.

we must remember that the times were difficult—they were not widely different in some respects from those we are now experiencing—and that for nearly forty years Morgan had been restraining the demands of successive generations of policy holders, so that he may have doubted if future demands could have been silenced by those who would succeed him. He may even have wondered whether he retained sufficient vigour to fight the old battles over again. Be that as it may, the decision was a mistake. Morgan did not foresee that the measure would mean a reduction of new business and then a loss of membership and influence until, many years after his death, the Society became, for a time, almost a closed fund.

On one occasion (1815) we find him giving a warning against thinking of surplus in terms of high prices which will fall quickly " were the peace of Europe disturbed," and agreeing with a suggestion that as much of the funds as possible should be put in mortgages in order to avoid depreciation : small wonder that he agreed, as his office had been increasing its investments in mortgages whenever possible for some years ! You will find that Morgan was well aware of investment problems, but I need not go into this aspect of his work in detail, as I discussed it fairly fully in 1918 (*J.I.A.*, li. p. 32).

In the course of his administration, Morgan had to fight demands for more, and more frequent, bonuses and suggestions for weaker reserves. He explained why he would not do what he was asked, and his explanations are generally simple and convincing, though occasionally he used an argument that strikes the reader as specious. He was confident that his conclusions were sound, and he was not afraid to stand up to opposition ; he had a refreshing way of telling the greedy what he thought of them, as, for instance, in 1809 when he said that the clamour for bonuses at short intervals came from " the very old and the new members : the former from the fear " of not surviving a period of ten years, and the latter from an eager- " ness to partake of profits from which they have never yet derived " any benefit, and towards which they can have contributed but " in a very small degree." He continues with a little subtle flattery : " Happily the liberality and good sense of the great majority have " hitherto succeeded in quieting the fears of the one and checking " the impatience of the other, and thus promoting ultimately the " real interests of both." Knowing all the time that the real check was William Morgan.

Towards the close of his career Morgan also had to face the considered criticism of better-informed people on points connected with the bonus system or valuation. If we may judge by the

tone of some of his replies Morgan resented this criticism, which was probably encouraged by the conservatism of his management. Perhaps in spite of his great ability he had outstayed his welcome, but it seems to me that on all questions of valuation he had much greater practical knowledge than his critics. I need not trouble you with Babbage's criticism, for instance, to which Morgan himself replied, on the whole convincingly, but some of you may remember that De Morgan in his "Essay on Probabilities" indulges in a criticism of Morgan some five years after his death. De Morgan does not seem to appreciate, as Morgan did appreciate, that a large sum must be carried forward, with a bonus system such as that in use at the time, for many years even if there were no new business.

De Morgan writes: "reversing the fable of Spenser, we should "write upon the door of every mutual office but one, *be wary*; but "upon that one should be written, *be not too wary*, and over it, "'Equitable Society.'" But, truth to say, Morgan was not "too "wary," and as we have seen, the division of two-thirds of the surplus was about right for the bonus system. De Morgan would, I assume, have declared too much bonus if he had been in Morgan's place, and would have left *his* successors to be sorry for it in the morning. Some other remarks of De Morgan with regard to the large amount of profits made in the very early years of the Society's existence and undivided * lead me to quote a statement Morgan makes in one of his addresses where he says, "should any Society, "reasoning from its success in its infancy, begin with large addi- "tions and flatter its members with still larger additions at stated "periods hereafter, it will most certainly disappoint their expec- "tations, or, by persevering too long in the attempt to realise "them, involve itself in ruin." † He produced some arithmetical evidence in support at the time, but only published it subsequently in his book on the *Rise and Progress of the Equitable Society.* It consists of a table showing the policy values by the Equitable Society's own experience, by the Northampton table, and by valuing the Northampton premiums by the Equitable table, and he points out that this last arrangement gives negative values for more than ten years at the early ages and for more than five years if the entry

* These old profits, or at any rate two-thirds of them, must have been divided long before De Morgan wrote!

† Some of the offices formed after the Equitable quoted its success and meant to copy the bonus system, but they lacked the initial restraint in giving bonuses.

ages are under 41. Although the net premium policy values are greater by the Equitable experience than by the Northampton table, the reserves do not differ much when the declared bonuses are large, and I think it is clear from the evidence that Morgan appreciated, as no one else did, except possibly his son, the essence of a valuation for bonus purposes.

There is another aspect of his work to which I have so far referred very little. Year by year from the time when he first became actuary of the Equitable and originally apparently at the suggestion of Price, Morgan worked out the number of assurances that "should have died" according to the Northampton table, and compared them with the number that actually died, and later on he compared lives as well as policies. The work was done as a matter of routine year by year with the accumulated result of the past years.* The rate of mortality was surprisingly stable during most of Morgan's administration. He observed that although the mortality differed greatly from that of the Northampton table at the early ages, it was identical with that mortality at the higher ages above 70, where there was no new business, and he assumed that, as his premiums were calculated by the Northampton table, he must regard the difference as due to selection. This is unobjectionable, but he overstates the case when he says† that the agreement over 70 affords "a striking proof of the accuracy of that table"—what a pity he did not say "suitability" of the table!

In 1800, when discussing the mortality that had been experienced, he said that "the Society for the last thirty years has only paid "*two* claims where the tables supposed that *three* would become "due: a circumstance which, in an institution of this magnitude, "would of itself be sufficient to establish the accuracy of the present "accounts." This statement is only true if we bring into account the profit from lapses which Morgan calculated, I find, when he made his valuations, or if the profit from this source approximated to the expenses.

This, however, is a digression from the comparisons with the Northampton table, and there is evidence that Morgan was too fond

* It may have been this record that led Morgan to make the following remark when referring to the use of the Northampton table for annuities: "With the least knowledge of the subject, it might easily have been "seen . . . that the extent of any loss (if it really existed) instead of six "years did not require as many hours to ascertain it" (*Rise and Progress of Equitable*, p. 5).

† *Rise and Progress of Equitable*, p. 43.

of using that table in much of his work,* but he had a good defence for his life office valuation, and was, in my view, working there on right lines.

We who call ourselves actuaries owe so much to Morgan that it is amusing to quote his remark that "it is not easy to account "for this affected appellation, nor for the practice which has lately "prevailed of appropriating it exclusively to the secretaries of "life assurance societies, with the exception of the new office of "Actuary to the sinking fund and national debt; which, however, "from its peculiar duties may possibly require a peculiar denomina-"tion." † The humour of the situation is that though Morgan thought the term "actuary" was an "affected appellation" for the kind of work he had to do, the word has been retained and the profession has been formed largely because Morgan showed there was room for it.

And there my outline of Morgan's life and work might end, but, as "parting is such sweet sorrow," may I linger a moment.

He was the first to show how to work out complicated benefits, involving several lives, from any mortality table; the first to value the liabilities of a life assurance company and appreciate the meaning of the result; the first to see that, with the valuations in use, a margin of surplus had to be carried forward to prevent his bonus system from breaking down; the first to set down the available sources of profit and obtain measures for them; the first to keep record of the mortality of a life assurance office, and to notice that there was such a thing as "select" mortality. Further than this, he was the first practical administrator of life assurance and a successful man of business.

* See, for instance, his evidence on Friendly Societies, 1825 and 1827. The 1827 report on this subject discusses mortality and refuses to accept Morgan's remarks about the Equitable, apparently because the Committee or its advisers failed to distinguish between "exposed to risk" and "new entrants." Morgan held that 1500 exposed in ten years was insufficient to give reliable information as to mortality under 20, and of course he was right. There were 7 deaths under 20, and 37 between 20 and 30.

† *Rise and Progress of Equitable.* Possibly the adoption of the term in the original deed of settlement of the Equitable was due to Edward Rowe Mores (an eccentric antiquarian: see *Dict. Nat. Biog.*), who seems to have had much to do with the drafting of the deed. His attractive style of writing is traceable in several of the early papers of the Equitable.

In contrast to the "affected appellation," Morgan on 15th March 1825 before the Committee on Friendly Societies said: "You have, in the Act of "Parliament, made use of the words, two actuaries, or professional men. The "people in the country have taken upon themselves this name. I have had "cases sent me, of club rules and orders, provided by people who call them-"selves actuaries, who are nothing but schoolmasters and accountants, and "some of the tables are exceedingly wrong. The mischief is now very great."

You may discount my claim for Morgan, because I cannot prove it up to the hilt; you may allow something for my enthusiasm; you may enlarge on his mistake when he was frightened about new business, and on his undue regard for the Northampton table; you may accept at face value the criticisms by Baily, Babbage, De Morgan and smaller fry; but, discount it as you will, it was a great achievement.

APPENDIX

William Morgan's Works

Papers to the Royal Society—

Electrical Experiments made to ascertain the non-conducting power of a perfect vacuum. *Phil. Trans.*, lxxv. p. 272. A short paper giving an account of two experiments. Read 1785.

On the Probabilities of Survivorship, etc. *Phil. Trans.*, lxxviii. p. 331 (1788).

On the method of determining from the real probabilities of life the value of a contingent reversion in which three lives are involved in the survivorship. *Phil. Trans.*, lxxix. p. 40 (1789).

The same (a continuation). *Phil. Trans.*, lxxxi. p. 246 (1791).
Do. Do. *Phil. Trans.*, lxxxiv. p. 223 (1794).
Do. Do. *Phil. Trans.*, xc. p. 22 (1800).

Books, etc.—

The Doctrine of Annuities and Assurances (with introduction and essay by Richard Price), 1779.

An Examination of Dr. Crawford's Theory of Heat and Combustion, 1781.

A Review of Dr. Price's writings on the subject of the Finances of the Kingdom, to which are added the three plans communicated by him to Mr. Pitt in 1786 for redeeming the National Debt, 1792; 2nd edition, "with a supplement stating the amount of the Debt in 1795," 1795.

Facts addressed to the serious attention of the People of Great Britain, respecting the expense of the War and the state of the National Debt in 1796. Four editions were published in 1796.

Additional Facts on the same subject, 1796. Four editions.

An Appeal to the People of Great Britain on the present alarming state of the Public Finances and of Public Credit, 1797. Four editions.

A Comparative View of the Public Finances from the beginning to the close of the late Administration, 1801. Three editions.

A Supplement to the Comparative View, 1803.

Memoir of the Life of the Rev. Richard Price, 1815.

The Principles and Doctrine of Assurances, Annuities on Lives and Contingent Reversions, 1821 (a revised edition of the Doctrine of Annuities, etc.).

A View of the Rise and Progress of the Equitable Society, 1828; 2nd edition, 1829.

Nine Addresses to Members of the Equitable. Printed at various times, and finally collected in one volume with other matter, in 1854.

Editions—

Price's Observations on Reversionary Payments. 5th edition 1792, and many subsequent editions.

Works by Dr. Price, with Memoir of his Life, 1816.

Dr. Price's Sermons, 1816.

Articles, etc.—

Note iv. p. 339. Vol. v. of *Scriptores Logarithmici.* Ed. by Francis Maseres. London, 1804. A demonstration of an approximation to the rate of interest in a deferred annuity-certain.

Articles on life-annuities, chance, funds and interest in Dr. A. Rees' Cyclopædia, 1819. (There is, so far as I can trace, no evidence in the Cyclopædia itself as to Morgan's authorship of these articles, but the preface acknowledges his help in connection with annuities. A pamphlet entitled " A Chronological list of books and single papers relating to the subjects of mortality annuities and life assurance. London, 1836," of which there is a copy in the Library of the Institute of Actuaries, ascribes the articles to Morgan. The articles are in his style and are worth reading; the articles on annuities and survivorships may also have been by him.)

Letter to *Times*, dated 30th June 1828, reprinted *J.I.A.*, x. p. 311.

Phil. Mag., vol. ii., New Series, Oct. 1827, no. x., p. 292, " Dr. Price and his followers," signed F.R.S., and vol. iii., Jan. 1928, no. xi., p. 30, signed F.R.S.

Evidence or opinions to House of Commons Committees on Poor Laws, 1817, Friendly Societies, 1825 and 1827.

References to Morgan's Life, Work, Family, etc.—

Nearly all the writers on actuarial, insurance or friendly society work in the first half of the nineteenth century refer to Morgan (*e.g.* Baily, Milne, Griffith Davies, etc.). Several references will also be found in the early numbers of the *Journal of the Institute of Actuaries.*

Article in *Dict. Nat. Biog.*

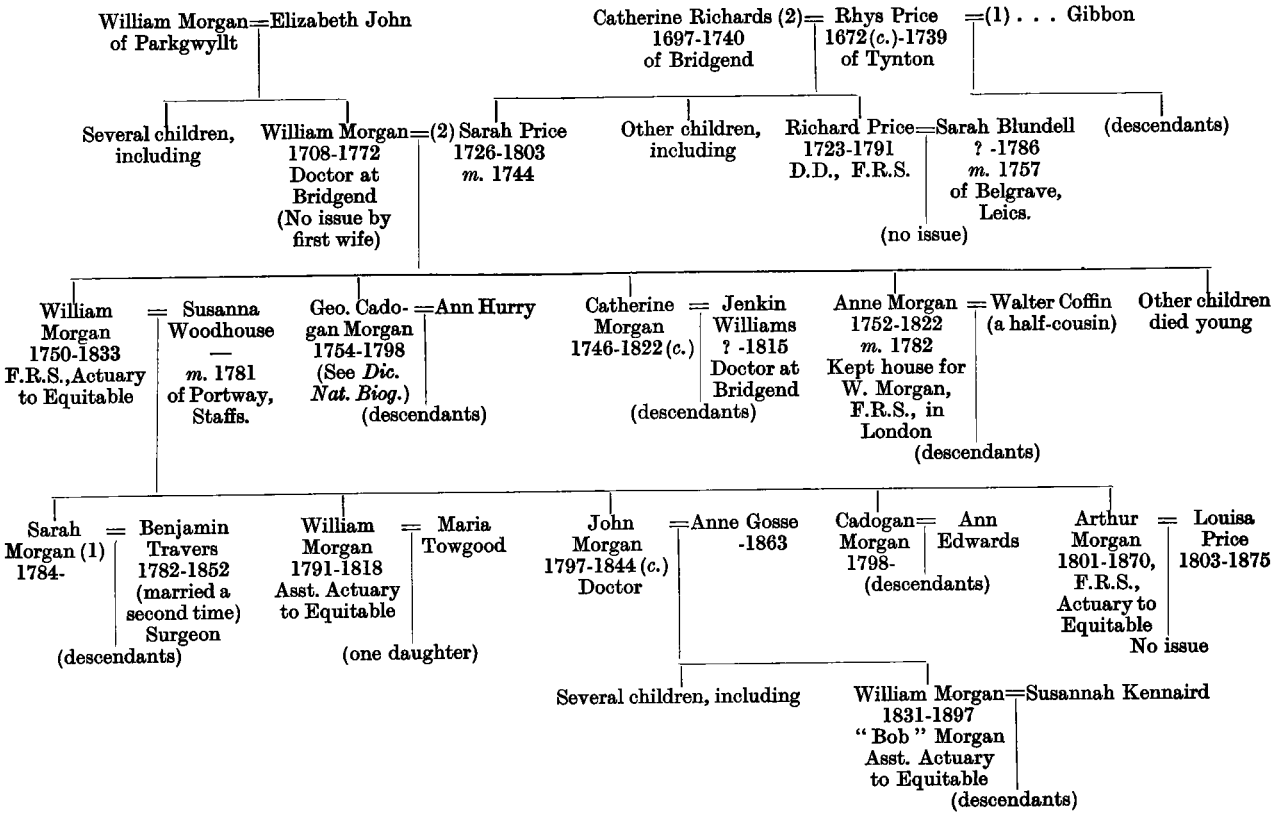
Obituary in *Gentleman's Magazine*, 1833, Pt. I. p. 569.

A Welsh Family, by Caroline E. Williams. London, 1893.

The Early Life of Samuel Rogers, by P. W. Clayden. London, 1887.

Investments a Hundred Years Ago, *J.I.A.*, li. p. 32.

Walford's *Insurance Cyclopædia.*


William Morgan of Parkgwyllt
Elizabeth John
Several children, including
William Morgan 1708-1772 Doctor at Bridgend (No issue by first wife)
(2) Sarah Price 1726-1803 m. 1744
Catherine Richards (2) 1697-1740 of Bridgend
Rhys Price 1672(c.)-1739 of Tynton
(1) . . . Gibbon
Other children, including
Richard Price 1723-1791 D.D., F.R.S.
(no issue)
Sarah Blundell ? -1786 m. 1757 of Belgrave, Leics.
(descendants)
William Morgan 1750-1833 F.R.S., Actuary to Equitable
Susanna Woodhouse — m. 1781 of Portway, Staffs.
Geo. Cadogan Morgan 1754-1798 (See Dic. Nat. Biog.)
Ann Hurry
(descendants)
Catherine Morgan 1746-1822 (c.)
Jenkin Williams ? -1815 Doctor at Bridgend
(descendants)
Anne Morgan 1752-1822 m. 1782 Kept house for W. Morgan, F.R.S., in London
Walter Coffin (a half-cousin)
(descendants)
Other children died young
Sarah Morgan (1) 1784-
Benjamin Travers 1782-1852 (married a second time) Surgeon
(descendants)
William Morgan 1791-1818 Asst. Actuary to Equitable
Maria Towgood
(one daughter)
John Morgan 1797-1844 (c.) Doctor
Anne Gosse -1863
Several children, including
William Morgan 1831-1897 "Bob" Morgan Asst. Actuary to Equitable
Susannah Kennaird
(descendants)
Cadogan Morgan 1798-
Ann Edwards
(descendants)
Arthur Morgan 1801-1870, F.R.S., Actuary to Equitable
Louisa Price 1803-1875
No issue

The President (Mr. Steuart Macnaghten), in introducing Mr. Elderton, said :—Ladies and gentlemen, we welcome to-night Mr. Elderton. We welcome him not only as an eminent actuary from the other side of the border but as a Faculty man, the members last Friday having unanimously elected him a Fellow of the Faculty. I think that all actuaries will agree that few men have done more for our profession than Mr. Elderton. Endowed by Nature with a wealth of mathematical genius, he in turn has freely given of his best for the benefit of his fellow actuaries. Mathematicians are not necessarily practical business men, but, in the case of Mr. Elderton, he is right in the forefront both in original research and in the solution of practical business problems. His works have been many and diversified, but, so far as I know, this is the first time that he has appeared in the rôle of a biographer. To-night he is giving us a paper on William Morgan, the first actuary in the sense of the term used by us to-day, and I think it is very fitting that at this, our first Sessional Meeting in the new Hall, the Paper should be given by our youngest Fellow on the subject of the oldest actuary.

I have thought for a long time what a wealth of material there is for a book of biographical sketches of famous actuaries. All professions should be proud to honour their famous men, but, as years roll by, memory fades, and much that is of interest falls into the limbo of forgotten things. It was, therefore, with very great pleasure that I heard that Mr. Elderton was going to address us to-night on that renowned actuary William Morgan, of the old Equitable, the oldest life assurance company in the world, of which office Mr. Elderton is the distinguished head.

Mr. Elderton, in reply to a vote of thanks accorded with acclamation, said that he had been most pleased to hear that he had been elected a Fellow of the Faculty of Actuaries in Scotland: he appreciated the honour fully, but he valued still more the kindness and the friendship that he knew lay behind the honour itself. His many friends in Scotland were so kind to him that they tempted him to find excuses to ignore his work in London in favour of visits to the North. He thanked the members present for the warm welcome they had given to him, and the President for his far too flattering remarks. He added that there was perhaps a touch of humour in the fact that the first sessional meeting in the new Hall was given up to a paper by an Englishman about a Welshman!