

EARLY ACTUARIAL WORK IN EIGHTEENTH-CENTURY SCOTLAND

A Lecture

by

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I must begin with an apology. Ideally, a paper submitted to a sessional meeting of the Faculty should both throw light on some point of actuarial theory and show how that theory can be applied to solve some practical problem. This paper makes not the slightest attempt to do either of these things. It must be regarded as a piece of sheer escapism, whose existence can be justified—if, indeed, it can be justified at all—only by the possibility that others besides myself may find it interesting to discover how, before our Faculty or even our science existed, men approached some of the problems with which we are still concerned, and to find that at least the beginnings of actuarial thought in Scotland go back considerably farther in time than perhaps we had supposed. I should add that this paper is not so comprehensive as its title might suggest, since it deals only with the work done by two men, Robert Wallace and Alexander Webster on widows' funds and population statistics, and by a third, Colin Maclaurin, on a widows' fund. Even within these limits I am sure that much remains to be discovered by enquirers more skilled or more pertinacious than I am.

In his history of the Faculty¹ A.R. Davidson wrote :

“ The actuarial profession arose in Scotland, as elsewhere, from the requirements of the life offices ”

and went on to show how the establishment of the first life assurance companies in Scotland in the early decades of the nineteenth century and the resulting demand for actuarial skills led to the foundation of the Faculty in 1856. He also pointed out, however, that, more than a century earlier, there were organisations in Scotland in need of the advice an actuary can give and cited as an example the “ Church of Scotland Ministers' and Scottish University Professors' Widows' Fund ” which was established in 1743 and which, he added, “ is still in robust and healthy existence ”.

It is strange that a fund of actuarial character with a continuous history extending over two and a quarter centuries should have received as little attention in our professional writing as this fund has. There is an outline of its early story in an address given by David Deuchar to the Actuarial Society of Edinburgh in 1894², but only a few brief passing references to it in our Transactions. Indeed, the fund has received more attention abroad than it has in this country, particularly from Alexander Mackie in his book *Facile Princeps*³, which is the history of the oldest American life assurance company, the Presbyterian Ministers' Fund. This company had its beginnings in a corporation which was set up in 1761 "in imitation of the laudable example of the Church of Scotland" for the relief of ministers and their widows. Mackie pays generous tribute to the pioneer work of the Church of Scotland, to the soundness of the principles on which the fund is based, and to the value of its example, an example also followed initially by the first Scottish life assurance company to be established, as the name Scottish Widows' Fund suggests. It is at these principles and at the men who evolved them that, I suggest, we might first look briefly tonight.

Credit for founding the Church of Scotland fund is generally given to Dr. Alexander Webster who was an eminent clergyman and a prominent figure in the Edinburgh of his day. Certainly he played a leading and, indeed, a vital part in setting it up, was the driving force behind its organisation and watched over its fortunes tirelessly from its inception until his death in 1784, but, in fact, the records of the fund suggest that the calculations on which the scheme was based, and which could be described as actuarial, were largely the work of another clergyman, Dr. Robert Wallace and of Colin Maclaurin the mathematician, who have therefore a good claim to be, if not the first Scottish actuaries, at least the first Scotsmen to think actuarially. As, in addition, Wallace thought and wrote a great deal on demographic questions—indeed, in the *Dictionary of National Biography* he is described as a "writer on population"—and as Webster also carried out the first census of Scotland in or about the year 1755 it seems that the lives and work of these men merit some reference in our Transactions.

Robert Wallace was born in 1697 at Kincardine "in the stewartry of Menteith and the county of Perth" where his father was parish minister. After attending the grammar school at Stirling the young Robert went in 1711 to Edinburgh University where his course of study included classes in language, logic, metaphysics, mathematics, physics, ethics, and theology. He was evidently both an able and popular student, and, in 1717, with some others he set up a debating

society called the Rankenian Club, the name being that of the proprietor of the tavern where the club's meetings were held. In this, as in most student societies, papers were read and discussed and the affairs of the world put to rights, but, despite its convivial environment, the club's aims were serious. Members entered into correspondence with Bishop Berkeley, who was so impressed with their grasp of his philosophical ideas that he invited them to go to Bermuda to staff the college he was planning to found there. Fortunately they declined the invitation and remained in Scotland, to whose national and literary life many of them made notable contributions.

As a student Wallace showed particular aptitude for mathematics and, indeed, in the session of 1720-21, during the illness of the professor of mathematics, Dr. James Gregory, Wallace conducted the mathematics classes with complete acceptance. He had decided, however, to enter the Church, was licensed in 1722 and in the following year was appointed to his first charge in Moffat. Here he remained until 1733 when he returned to Edinburgh to become minister of New Greyfriars Church. In 1735 he was one of the group which, under the leadership of Colin Maclaurin, who had succeeded Gregory as professor of mathematics at Edinburgh, founded the Philosophical Society. Wallace later made some important contributions to the proceedings of this society which, in 1783, was reconstituted and enlarged in scope to become the Royal Society of Edinburgh.

After the civil disturbances of 1736 which came to be known as the Porteous Riots, Wallace fell into disfavour with the authorities because, along with some other ministers of the Church of Scotland, he refused to read from his pulpit each month a government proclamation threatening the severest penalties to anyone giving aid or comfort to the rioters, but after the fall of Walpole's government in 1742, his position was reversed and he became one of the new government's chief advisers on ecclesiastical appointments in Scotland. This was a post of considerable importance, because the system of patronage still prevailed and something like one third of the charges in Scotland were in the grant of the crown. Prior to this, in 1739, he had been appointed minister of the Edinburgh charge of New North, where he remained until his death in 1771, and it was soon after taking up this charge that his connection with the widows' fund and with Alexander Webster began.

At this time Webster was minister of the Tolbooth Church in Edinburgh which worshipped in what was then a rather ramshackle corner of the Kirk of St. Giles, and took its name from the adjoining Tolbooth prison. It may be remembered as the setting for a dramatic

incident in an early chapter of Sir Walter Scott's *Heart of Midlothian* when one of the condemned smugglers escapes from his guards during his last church service before execution. Webster, who was born in 1707, was the son of a former minister of the Tolbooth, had been educated at the High School and University of Edinburgh where, like Wallace, he had shown more than a little mathematical ability, and, before coming to the Tolbooth in 1737, he had been for four years minister of the ancient burgh of Culross in Fife. Indeed, for Webster, 1737 was something of an *annus mirabilis*, because soon after he came to Edinburgh he married a Miss Mary Erskine, a young lady of good family and considerable fortune. The story is told that Webster was asked by a very bashful friend to approach Miss Erskine and put to her a proposal of marriage on the friend's behalf. The young minister expended his eloquence on the lady in vain until finally she interrupted with the remark "You would come better speed, Sandy, if you spoke for yourself". As one narrator rather coyly puts it, "the hint was too obvious to be overlooked and its promise too agreeable to be neglected". Sandy did speak for himself and succeeded. It would only be a slight exaggeration to say that they lived happily ever after.

From 1698 onwards the Church of Scotland had made several attempts to organise financial provision for the widows and orphans of its ministers. Various schemes, mostly of a voluntary or charitable nature, had been put forward and tried but all had failed through inadequate support or imperfect organisation. In 1741 the need for action was again recognised and a group of Edinburgh ministers, which included Wallace and Webster, applied themselves to the problem. Clearly Webster was the driving force. He was a man of great energy and initiative and although he does not appear to have had any official status or authority, he wrote to all the presbyteries in Scotland asking them to produce from their records information about the numbers of their members dying, the numbers leaving widows with and without children, the numbers of widows still alive and unmarried and so on, the statistics to cover the period from March 1722 to March 1742. To those who know the ways of presbyteries the fact that full or nearly full replies were received to these apparently unofficial enquiries will sufficiently attest the force of Webster's personality.

Meanwhile, Wallace was applying himself to consider the theoretical basis of a widows' fund and set out his ideas in a manuscript which has been preserved in the records of the fund and which may well be one of the earliest actuarial documents in the world. It is almost certainly the first attempt to organise scientifically a widows' fund on

an annual premium basis and so is of historic interest to actuaries. To anyone, whether actuary or not, it is a fascinating illustration of how a man of intelligent mind, with no resources but his own intelligence, can attack a completely new and strange problem and arrive at eminently sensible conclusions. The manuscript, which is undated but seems to have been written in 1741 or 1742, is reproduced in full in Appendix I, and although it would take too long to go through it in detail, I would like to draw your attention to one or two points in it :

- (i) The argument in paragraph 3, which leads him to conclude that "every widow may have the quadruple of what her husband pays in and therefore a triple cannot be too much". This is an example of the intuitive argument by which actuaries still put a rough check on their formal calculations, and it is also probably the first recorded case in actuarial history of a contingency margin in a premium. In fact, the ratio of annuity to contribution finally adopted was just under four.
- (ii) The number of what we now regard as the classical problems of widows' funds which Wallace appreciated e.g., health risk, selective force of marriage, husband older than wife, entrants at old ages, etc.
- (iii) The simple and practical draft rules he proposes, many of which with minor alterations could appear in the constitution of a modern fund.

As the returns from the presbyteries came in, Wallace set to work and made numerous calculations, some based on partial, others on complete or nearly complete statistics. He clearly realised that he was dealing with as close an approximation to the stationary population of actuarial theory as is likely to be achieved in real life, since the number of parishes, and hence of ministers, in Scotland was at this time virtually constant and most men entered the ministry at age 26 or thereby. Accordingly he used Halley's Breslaw table to make a population estimate assuming an annual entry to the ministry of 30 men aged 26, and drew up a table of the numbers surviving to each year of age. By carrying the calculation up to age 84, the limiting age of Halley's table, he found that the total population on his assumptions would be 927, compared with the population of 970 which the 26 annual entrants to the Church appeared to support in real life.

If the returns were really completed up to March 1742 then subsequent progress was incredibly rapid. A special meeting of the General Assembly was called on 8th May 1742 "for receiving any schemes or proposals that may be offered for raising a fund for the

widows of Ministers", at which meeting "any member of this Assembly or minister of this church may be heard". This was probably done so that Webster, who was not a member of the Assembly that year, could present the plan which Wallace and he had devised. It was a sophisticated one, offering a choice of four grades of contribution ranging from $2\frac{1}{2}$ guineas to $6\frac{1}{4}$ guineas with proportional widows' annuities ranging from £10 per annum to £25 per annum. In addition, a capital sum or "stock" equal to ten times the annuity was to be payable to the children of those members who left no widow. There was also a provision that both annuities and capital sums would be reduced to the dependants of members who died in the early years of membership—probably the earliest recorded example of an initial debt.

The Assembly rejected this plan "it being alledged . . . that it would not sufficiently relieve the Indigent and Necessitous and being apprehensive of some Difficulties in managing a capital . . ." ⁴ Instead, it put forward for consideration by presbyteries an alternative plan under which all widows would receive an annuity of £20 and there would be no benefit for children. Members would be assessed yearly an amount sufficient to meet the annuities arising that year, the maximum assessment to be £4. Should that prove insufficient the deficit would be met by levy on the previous year's entrants to the ministry up to a maximum of £20, and, if more should still be needed, ministers with the highest stipends would be called on to pay more than £4.

The impracticability of the Assembly's plan becomes immediately clear when we consider the level of stipends in 1742. The minimum stipend for ministers of the Church of Scotland had been fixed in 1633 at £45 per annum and an enquiry to be made in 1749 would show that some 200 ministers were even then receiving this minimum stipend or less. The payments which would eventually fall on new entrants might therefore be as much as half their first year's stipend and were clearly too high to be contemplated, particularly as Wallace's calculations showed that the £4 limit would probably be passed in 11 or 12 years and the £20 maximum would be in force from about the 16th year onwards.

Quite rightly, the presbyteries were strongly critical of this scheme and, faced with their objections, the Commission of Assembly which met in November 1742 took the familiar course of appointing a large committee of both ministers and laymen including Wallace and Webster. With uncharacteristic but commendable speed this committee sent a revised plan to the presbyteries in January 1743, inviting them to comment on it before March or, at latest, before the

meeting of Assembly in May. This timetable was adhered to and the *Scots Magazine* for May 1743, in reporting the proceedings of the Assembly, was able to say :

“ The Scheme for providing an annuity to the widows and a stock to the children of ministers . . . was considered in a committee of the whole house and with some amendments transmitted to the Assembly : who, after reasoning, approved of them and resolved to apply for an act. ”

Appropriately, Wallace was Moderator of this Assembly and he and another Edinburgh minister, the Rev. George Wishart, were appointed commissioners to arrange for the necessary bill to be prepared and presented to Parliament.

The scheme now approved was the same as the one which the Assembly had rejected the previous year, with two modifications to meet the objections which had then been raised :

(i) Full benefits were to be payable from the beginning of membership.

(ii) To reduce the problems of investment each member was required to take a loan of £30 from the fund at 4% interest. These loans were to be taken up as money became available, an order of presbyteries being prescribed for this purpose. These loans would eventually total almost £30,000, and the fund was to be allowed to accumulate a further £35,000 of assets, after which any excess would be used to pay additional benefits to the children of members.

The scheme was to be optional for existing ministers but compulsory for future entrants to the ministry. The principals and professors of the Scottish universities, many of whom were at this time ministers of the Church of Scotland anyway, were to be eligible for membership if the individual universities chose to join, and in the event all did.

For this scheme, too, Wallace made very extensive calculations. He made various assumptions about the proportions of entrants who would select the different levels of benefit and, with a meticulous care which we can admire to a point just short of imitation, calculated, using Halley's tables, the expected number of widows in each grade correct to six places of decimals. Using the “ guess ” in his original memorandum that the widow's annuity might be about quadruple the annual contribution, he traced the probable future progress of the fund up to the time when the maximum number of widows would be entitled to benefit. After many pages of laborious but orderly arithmetic he concluded that a tax of $2\frac{1}{2}$ guineas for the lowest class

with other classes in proportion would, as he put it, "answer all exigencies" and this was the basis adopted.

After the plan had been approved by the Assembly in May 1743, progress seems to have been uninterrupted. In July a circular was sent out signed by Wallace as Moderator detailing the provisions of the scheme and commending it to the Church. There is no record of any objections. A draft bill was prepared with the help of some eminent Scottish lawyers and, after the Commission of Assembly at its November meeting had approved it, Wallace and Wishart with the good wishes of their brethren left for London where they arrived on 3rd December. (Perhaps we might pause for a moment to remind ourselves what that journey then involved. Until 1760 only one stage-coach regularly left Edinburgh for London each week. Depending on the weather and the condition of the roads which in winter were frequently impassable, the journey took anything up to fourteen days and passengers usually made their wills before setting out.)

The timing of the visit could hardly have been more unfortunate. In court and government circles much anxiety already existed about the possibility of rebellion in Scotland—a possibility which was to become reality in 1745. In 1742 Walpole's government had fallen in discredit and the prestige of Parliament, as well as its ability to deal effectively with the problems of the nation, was suspect. Altogether the chance that Parliament would find time or would be inclined to consider, let alone approve, a purely Scottish bill aimed at setting up a strange new scheme to help the widows of Scottish clergymen seemed less than minimal. Private correspondence shows that many leading figures in public life in Scotland took this view. On the other hand Wallace, as we have seen, was the government's adviser on ecclesiastical matters in Scotland and in this capacity had served them quietly and well, so that he had some claim to official goodwill. Moreover, though he was known to his friends as "the philosopher" there seems to have been nothing abstract or impractical about his thinking or his actions. Wishart and he met all the Scottish members of Parliament and sought the support of everyone who might ease the passage of the bill. In all this they were advised, though not noticeably assisted, by a steady stream of letters from their committee in Edinburgh, to few of which they seem to have replied, and then only to say that the committee's advice had been overtaken by events and that they had done something quite different from what they had been told to do. The committee's letters, which show a steadily mounting sense of frustrated authority, have been preserved among Wallace's papers and on the folder containing them he has written the pleasantly wry comment :

“Messrs. Wallace and Wishart served the church with fidelity and care, they succeeded and they had the thanks of the General Assembly and all good men. But when they were at London several peevish and unwise orders were sent them and they learned by experience how difficult it was to be directed and advised by a Committee at Edinburgh.”

The bill went through all its parliamentary stages in the Commons and the Lords and received the royal assent on 3rd March 1744.* The effective starting date of the Fund was fixed as 25th March 1744, and we may reflect a little sadly that these figures must be well below the par for a similar legislative course today. At the General Assembly in May Wallace and Wishart were thanked for their “faithfulness and diligence in soliciting the obtaining of the Act”. Webster also received the thanks of the Assembly “for the extraordinary pains and trouble taken by him in the rise and progress of the scheme”.

At this point, with the Act on the statute book and the Fund in being, it is convenient to look at the part played in its founding by Colin Maclaurin, who had been professor of mathematics at Edinburgh University since 1725.

To actuaries of my generation Maclaurin is known as the co-author with Euler of a formula of numerical integration, although in fact this was probably among the least of his achievements. He was born in 1698, the son of an Argyllshire minister who, after the early deaths of his parents, was brought up by his uncle who was also a minister in Argyll. He showed early and outstanding promise as a mathematician and at the age of 15, when graduating from Glasgow University, he delivered and defended a public dissertation on the power of gravity in which he showed his grasp of the then revolutionary principles of Newtonian physics. After some years of quiet study at his uncle's manse he was appointed professor of mathematics at Aberdeen shortly after his nineteenth birthday. His first book, dealing with some geometrical problems, quickly followed and earned him the fellowship of the Royal Society at the almost indecently early age of 21. During a visit to London he made the acquaintance of Sir Isaac Newton, who formed the highest opinion of the young man's ability. In 1725, when an appointment to the Edinburgh chair of mathematics was made necessary by the incapacity of its holder, Newton pressed Maclaurin's claims on the Corporation with whom

* Its full title was “An Act for raising and Establishing a Fund for a Provision for the Widows and Children of the Ministers of the Church of Scotland, and of the Heads, Principals, and Masters of the Universities of St. Andrews, Glasgow, and Edinburgh” (17 George II, cap. 2). King's and Marischal Colleges, Aberdeen, joined later.

the decision lay and even offered, if the payment of two salaries created any financial problem, to pay part of Maclaurin's salary himself.

By this time Maclaurin had established himself as a mathematician and thinker of international reputation second in Britain only to Newton. He was, moreover, a brilliant and popular teacher and his lectures made mathematics one of the fashionable subjects of study in the Edinburgh of the 1730's. He was also much in demand as a consultant and advised on such diverse questions as the preparation of new maps of northern Scotland, exploring for the long-sought North West passage, dredging the estuary of the River Clyde, and, with the Customs and Excise as client, the best method of estimating the volume of liquid in a container. His last remit was probably his strangest. In September 1745 he was one of a small group of Edinburgh citizens who pressed on a reluctant Lord Provost the need to do something to defend the city against the advancing Jacobite army. Maclaurin's particular task was to repair the fortifications of the castle and the walls of the city. With such helpers as he could muster, including his pupil the architect-to-be Robert Adam, he toiled prodigiously in the few days before the rebel forces reached the city, but, unfortunately, his work was never tested as the government troops under Sir John Cope who were to man the defences were still on their way from Aberdeen when Prince Charles and his men entered the city.

As a result of these exertions and of subsequent hardships while avoiding capture by the Jacobite forces Maclaurin contracted an illness from which he died in June 1746 at the age of 48, a sad loss to science and to Scotland. Until a few hours before his death he was working on a book entitled *An Account of the Philosophical Ideas of Sir Isaac Newton* which was published posthumously in 1748. It contains a biographical note based on a memorial lecture delivered by Alexander Monro, who was Dean of the Faculty of Medicine at Edinburgh University and a close friend of Maclaurin. This memoir contains the following passage :

“ . . . but what must have given him a higher satisfaction than anything else of this kind . . . was the calculations he made relative to that wise and humane provision which is now established by law for the children and widows of the Scotch clergy and of the professors in the universities . . . In contriving and adjusting the scheme Mr. Maclaurin had bestowed great labour ; and the gentlemen who were appointed to solicit the affair at London own that the authority of his name was of great use to them for removing

any doubts that were moved concerning the sufficiency of the proposed fund or the due proportion of the sums and annuities."

Coming from such a source, these words must carry great weight. Indeed, it is difficult to believe that Maclaurin would not be involved, or at least asked for advice. Wallace and he were close friends, and, if you are lucky enough to count one of the great mathematicians of Europe among your friends, you will naturally consult him when you are involved in new and strange calculations. In the records of the fund, however, the only signs of Maclaurin's involvement are two letters and a sheet of tables marked "Tables for the Widows' Scheme 1743". On the outside of the sheet of tables there is a note in Wallace's writing, "I think they were made by Mr Colin Maclaurin". The headings of the tables and the letters are reproduced in Appendices II, IV and V, along with a third letter which is in the library of Edinburgh University and which helps to explain the other two (Appendix III). It will be seen that the letters are dated after the scheme had been approved by the Assembly and seem to have been written by someone who had been asked to examine and comment on the scheme and not by one who had any claim to be its author. No doubt, in addition to any informal discussions which Maclaurin may have had with Wallace, he would be asked by the university authorities to report on the soundness of the plan before they committed the university to join. The letter of 3rd June is almost an actuarial certificate, bearing the authority of Maclaurin's name, which Wallace and Wishart would certainly use when they were lobbying for the bill in London, as Maclaurin's biographer suggests. Indeed, the letter may have been requested for this purpose.

Once the fund was in being, Wallace's interest in it seems to have diminished. He was one of the trustees who attended meetings, served on committees and occasionally acted as chairman, but there is no evidence in the trustees' minutes that he acted in any sense as a leader. He had, of course, many other interests. In 1753 he published a book with the title *A Dissertation on the Numbers of Mankind in Ancient and Modern Times*, the substance of which had earlier appeared as a paper to the Philosophical Society. It is an impressive display of erudition in which many of the references in ancient literature to the numbers of peoples or armies are used to make estimates of population and in which he sharply disagrees with the arguments and conclusions of a chapter in David Hume's book *Political Discourses*. For all Wallace's learning, however, we may today doubt whether, for example, the statements of a victorious

general regarding the number of the enemy whom he killed or took prisoner make a firm basis for estimating the population of the defeated nation, although we may have to admit there is no better available.

In 1761 Wallace published another and more important work entitled *Various Prospects of Mankind, Nature and Providence* which so far anticipated the thesis later put forward by Malthus that Hazlitt⁵ in more than one essay accused Malthus of borrowing all that was of substance in his book from Wallace.

In the fierce ecclesiastical controversies of his time Wallace seldom became publicly involved. He was widely respected both inside and outside the Church for his intellectual abilities and his personal qualities brought him many friends and few enemies. One historian, Sir Henry Craik, has written of him⁶:

“ It was, indeed, chiefly by his amazing versatility that he was characteristic of his time: and in the midst of all his various activities and speculations he found time for the delights of social intercourse, of which Edinburgh was then the choicest of centres, and left behind him, when he died in 1771, a memory of the most cultivated, the most ingenious, and the most courteous of companions. ”

To an audience in Edinburgh the manner of his death is perhaps of some interest. In the early part of the month of May 1771 he went for a walk in what was then the pleasant open country to the north of this hall. He was caught in a snowstorm, contracted a chill, and from the resulting complications died in July.

In contrast to Wallace, Webster's connection with the fund remained close and active. He was involved in all its activities from designing the clerk's record books to supervising the building of a hall where the trustees could meet. He was severely and publicly critical of the older ministers because they opted for the largest annuities and of the younger ministers because they did not join the fund at all, and he was quick to see that this made Wallace's estimates of the fund's future progress too optimistic, particularly as it was soon apparent that there had been errors in the information supplied by the presbyteries which had resulted in the probable number of widows being underestimated. Out of a possible 962, only 827 had elected to join, which meant that the fund could not grow as quickly as the forecast required. Accordingly, in 1747 a committee was appointed which included, besides Webster and Wallace and other clergymen, Lord Provost Drummond, Matthew Stewart, who had succeeded Maclaurin

as professor of mathematics at Edinburgh, and Alexander Chalmers, chief accountant to the Customs and Excise in Scotland. To deal with the situation the committee put forward a proposal which, as they said, "had frequently been suggested to some of the Trustees by the late ingenious and accurate Mr. Maclaurin" and which is referred to in the tables and letters of the Appendices, namely, that if a member die before the rates he has paid amount to three years' annuity the widow's annuity will be reduced to half until the balance is made up. The committee's proposals were approved by the Assembly and an act of 1748 amended the fund accordingly. It also increased from £35,000 to £50,000 the amount which the free capital must reach before any additional benefits could be paid.

To support its proposals and to explain them to the members the committee published a memorandum⁴ with very extensive calculations showing the rise and progress of the fund and its probable future growth if the amendments were adopted. A similar memorandum with further calculations followed in 1759. These calculations were all based on Halley's Breslaw table, average numbers of yearly entrants, average ages and so on, and as actuaries we can note with interest that their forecasts proved uncannily accurate. By 1758, for example, the fund amounted to £47,313 : 19 : 9 compared with a forecast of £47,401, and by 1765 to £58,347 : 17 : 8 compared with a forecast of £58,348 : 17 : 8. Could any computer-based estimate of future cash flow do better?

By 1748 Webster had become a well-known figure in the life of Edinburgh and indeed of Scotland. He was a very popular, though not apparently a very profound, preacher whose church was packed every Sunday, so that one Edinburgh citizen was heard to hope that it would be easier to get into the kingdom of Heaven than it was to get a seat in the Tolbooth Kirk. In 1753 he was elected Moderator of the General Assembly and about this time he was apparently asked by someone in authority to carry out a census of Scotland to discover how many fighting men the country could be expected to muster. No doubt in the official view the natural pugnacity of the Scots would be better employed in facing a foreign army than in assisting Charles Edward Stewart in a repetition of 1745. Again Webster approached this completely unfamiliar task in a characteristically practical and forthright way. Though the widows' fund he had, as he put it, "established a correspondence with many of the ministers of Scotland". This is possibly a polite eighteenth-century euphemism meaning that he had written them stern letters telling them to send in their statistical returns or pay their contributions to the fund more promptly, and that they had learned to do what he asked. He was

also chairman of the Society for Propagating Christian Knowledge, a charitable organisation which helped to pay the costs of providing schools in rural parishes, particularly in the Highlands. He asked each minister to count the number of his parishioners, more than a hint being given to the members of the second group that if they did not co-operate the grants for their schools might stop.

The results of this census, which is generally taken to relate to the year 1755, though some of the data may have been collected either earlier or later, have been analysed by the late Mr. J. G. Kyd, our former President, and are published in the proceedings of the Scottish History Society (1952)⁷ so I shall not discuss them further here, except to say that Webster estimated the population of Scotland to be 1,265,380, of whom he thought one-fifth "may be reckoned effective men". According to Dr. J. C. Dunlop this was only the third census taken anywhere in Europe since the fall of the Roman Empire, the previous ones being in Sweden in 1749 and in Austria in 1754. It is certainly the only national estimate of population in Britain made prior to the first official census of 1801 on which any reliance can be placed.

Whatever the purpose of Webster's enquiry, his manuscript remained in the Advocates' Library and his results do not appear to have been published until Kyd's paper appeared in 1952, though the figures were examined by Dr. Dunlop in 1921 when he arranged for a copy of them to be put in the National Library of Scotland. This seems to suggest that Webster was not allowed to use his results for the other purposes which he clearly saw they might serve. For example, he pointed out that a table he had constructed showing the population according to age "might serve several purposes particularly for calculating the probabilities of life and consequently for estimating the value of annuities in Scotland with more exactness than any Tables yet extant." From the same table he deduced that "the generality of People in Scotland live to a greater age than at London, and not to so great an age as at Breslaw". I have found no evidence, however, that he brought his census information to the service of the widows' fund.

By the time he became Moderator in 1753 Webster had emerged as the accepted leader of the Evangelical party in the Church of Scotland. This party claimed to have inherited and to maintain the pure doctrine of the Covenanters in all its austerity, and had no sympathy for the more tolerant views of their opponents, the Moderates, to whom, incidentally, Wallace belonged. Between the two parties disagreements were frequent and bitter, and in the resultant debates Webster made many enemies. It is possible that his reputation has

suffered somewhat because many contemporary references to him come from the writings of his ecclesiastical opponents.

From the long list of pleasures which the Evangelicals did not permit themselves one notable omission was the consumption of claret, and in this respect also Webster was their acknowledged leader. That shrewd commentator on eighteenth-century Scotland and Scotsmen, John Ramsay of Ochtertyre, wrote :

“ It was hardly in the power of liquor to affect Dr. Webster’s understanding or his limbs ”

and, clearly, he wrote in envy and not in criticism. In support of Ramsay’s statement we may note that Webster spent the evening of 17th August 1773 in the company of Dr. Johnson and Boswell and emerged apparently unscathed, for Boswell reported⁹ :

“ At supper we had Dr. Alexander Webster, who, though not learned, had such a knowledge of mankind, such a fund of information and entertainment, so clear a head and such accommodating manners, that Dr. Johnson found him a very agreeable companion. ”

A later historian¹⁰ after describing Webster as the most able businessman of the whole city who made the plans for the New Town adds that he

“ . . . combined the clearest of heads with the most unctuous of spirits, was the life of the supper parties of Edinburgh any time between 1760 and 1780, could join over a magnum of claret on Monday with gentlemen of not too correct lives whom he had professionally consigned to perdition on Sunday. He could pass with alacrity and sincerity from devout prayers by a bedside to a roystering reunion in Fortune’s tavern and return home with his Bible under his arm and five bottles under his girdle. ”

Whether Webster actually “ made the plans for the New Town ” we may take leave to doubt, but he was a member of the Lord Provost’s committee which did and he would certainly make his contribution. One cannot picture Webster in the role of sleeping partner.

Webster seems to have become recognised as something of an authority on widows’ funds. In January 1768, for example, the United Incorporations of St. Mary’s Chapel sought his advice on how to set one up. This body, which is still in existence, was formed in 1475 by the union of various guilds of craftsmen in the city of Edinburgh such as masons, wrights, coopers, painters and others. Entrants were required to execute a test piece of work to the satisfac-

tion of examiners before they were admitted to the privileges of membership which included payments to widows and dependants. These had been met by levying the members on an assessment basis but Webster recommended a scheme which in many of its provisions followed closely the pattern of the Church's scheme but with one scale of contributions and benefits. This plan was put into operation in March 1768—again we may wistfully ask whether it would be done as quickly today—and it is still in healthy existence, though with a small membership.

The Church of Scotland widows' fund enters what may be called official actuarial history in 1771 when Richard Price, who was by then consultant to the Equitable Life Assurance Society and who is now remembered chiefly as the author of the Northampton Tables, published his book *Observations on Reversionary Payments*. In it he criticised the Church of Scotland scheme on the ground that the contributions were too low. Webster reacted immediately and on 4th October 1771 he wrote Price a letter of nearly 5000 words¹¹ in which, as he put it,

“ I take the opportunity of acquainting you with some essential parts of the scheme of which I find you had no information and to explain others of which your information has been imperfect. ”

Price replied on 21st October—which in 1771 was certainly by return—and agreed that he had not fully understood the plan and promised to rewrite the offending passage in later editions. These, in fact, commended the soundness of the plan and paid tribute to the “ great ability and faithful Zeal of the Rev. Dr. Webster, its founder and conductor ”. After Price's death further editions of the book were prepared by Price's nephew, William Morgan, and as it remained a standard actuarial textbook for nearly a century, the existence and reputation of the fund came to be widely known.

The fund's first connection with the Faculty came through W. T. Thomson, who valued it at November 1849 and again at November 1861. As we might expect, the reports on these valuations—copies of which are in our library—are models of their kind, lucid and comprehensive, with all the arguments impressively supported by statistics. The valuation of 1849 was an interesting one as it covered the period of the Disruption of 1843 when 270 ministers left the Church of Scotland to found the Free Church. They retained their rights under the fund and as the vacant parishes were filled by new entrants the membership and liabilities of the fund increased. The financial consequences to the fund were, however, safely overcome. Indeed, it is an interesting example of the long-term aspect of some

actuarial affairs that the rates of contribution, which had been increased in 1814 from 2½ to 3 guineas for the lowest grade with proportionate increases in the other grades, were still in force when the Churches reunited in 1929. At that date the basis of the fund was changed for future entrants, but there are still a few ministers in the active service of the Church of Scotland who were members of the fund before 1929, who are paying the contributions fixed in 1814 and whose benefits follow the pattern laid down by Wallace and Webster in 1743.

In conclusion, I would like to record my thanks to those who have helped me, in particular to the Rev. A. Ian Dunlop, the present Chairman of the Trustees of the Churches and Universities Widows' Fund, who is an authority on the fund's history and has been very generous in passing on his knowledge, and to the Rev. H. R. Sefton and to Mrs. Norah Smith who have kindly made available to me the results of their research into Wallace's theological and literary work.

I end as I began—with an apology for detaining you so long in the byways of two hundred years ago. I confess that I am under the spell of the curious magic of eighteenth-century Edinburgh which caused everything done in that time and place to be done well, whether it was setting up a widows' fund, establishing a medical school or building a new town. I confess, too, that I find it interesting and heartening to discover that, in this city, before any of the problems which concern the actuary had been scientifically approached, three men of such diverse character and abilities as Maclaurin, Wallace and Webster were addressing themselves to some of the more complicated actuarial operations with that mixture of theory and commonsense which we flatter ourselves is still the mark of the good actuary today. I am very happy to find them among my professional ancestors.

REFERENCES

1. A. R. Davidson, *History of the Faculty of Actuaries in Scotland 1856-1956*.
2. D. Deuchar, "Notes on Widows' Funds". *Transactions of the Actuarial Society of Edinburgh*, Vol. iii, 61.
3. Alexander Mackie, *Facile Princeps*, Chap. VIII.
4. This is a quotation from a report issued in 1748 by the Committee appointed to review the progress of the fund. A copy of this report will be found among the records of the fund in the Scottish Record Office.
5. Examples are the essays entitled: "An examination of Mr. Malthus's Doctrines"; "On the originality of Mr. Malthus's Essay"; "Queries relating to the Essay on Population".
6. Sir Henry Craik, *A Century of Scottish History*, Vol. 1.
7. J. G. Kyd, *Scottish Population Statistics*. Scottish History Society, Vol. XLIII 1952.
8. *Scotland and Scotsmen in the Eighteenth Century from the Mss. of John Ramsay of Ochtertyre* (ed. Allardyce).

9. James Boswell, *Journal of a Tour to the Hebrides with Samuel Johnson LL.D.*
10. H. G. Graham, *The Social Life of Scotland in the Eighteenth Century.*
11. This correspondence was published by Murray and Cochrane. There is a copy in the National Library of Scotland.

APPENDIX I

*Manuscript in Wallace's handwriting, undated,
but probably written in 1741 or 1742*

Proposals for raising a fund for jointures to the widows of such gentlemen as have not lands, estates nor great sums of money but live by their business or yearly income which depends on their lives

1. It is proposed that a society be formed of the husbands, adventurers the contributors to this fund.
2. That every husband pay in yearly to this society what sum he thinks proper during his life & that his widow shall draw after his death a proportionable sum during her life.

This method is judged better than that a compleat sum be given in all at once because this proposal is principally intended for gentlemen who have not great sums of money but may be able to spare something out of their yearly income.

Besides it will be easier to settle a sum for the widow in this manner than if a great sum be given at once.

3. It is experience alone & a nice calculation that must determine the proportional sum the widow is to have after the husband's death but a beginning may be made by allowing triple the sum the husband payed in during his life so if a husband payes yearly 10L the widow has 30L if he pay 30L she draws 90L during her life.

It is judged this proportion will not be too great considering that the husband has as good if not a better chance to be the survivor so the half or more than the half of the widows will want no jointure which alone makes the Society able to give double or near to double of what the husbands pays (for by the exactest calculation the Society is not to be allowed to be very rich but to depend chiefly on their yearly incomes and not on the rents of lands or interests of money). But besides this as the ordinary time of marrying and consequently of entering into this society (as we shall see afterwards) is about 30 years of age and persons at 30 by the bills of mortality may be supposed to live about 28 years, this makes the common time that married persons live together about 28 years and 58 to be the common time when a woman is a widow. but persons at 58 years of age by the bills of mortality have an equal chance to live only 13 years which is not half the time that married persons live together That is to say the Society has only half the number of widows to provide

and this half only half the time of their husbands contributing yearly to the Society ; that is every widow may have the quadruple of what the husband pays in and therefore a triple cannot be too much.

But the proportioning of this sum according to the exigencies of the Society must be left either to the Court of Directors or to the annual meeting of the whole contributors as shall be most expedient.

4. Married persons are supposed to be much about an age or they may be supposed to have nearly an equal chance for living tho' the husband be somewhat elder because of the risk of bearing children.

It is proposed therefore that if the husband be not above 10 years older than his wife he be allowed to enter into this Society according to the above proposals.

5. But if the husband be more than 10 years older than his wife besides the yearly sum he payes, for every year above 10 he must give a premium for his privilege of entering into the Society. This premium is to be payed all at once at entering into the Society or at the outmost at 3 terms. The Determination of this premium depends on a nice calculation. Thus suppose a man be 15 years older than his wife had he been 5 years younger than he is he had been free, to make all equal then he must pay 5 years advance, that is 50L of premium if he is to pay yearly 10L. But this will make too great a sum payable as a premium there must therefore be some abatement made by making it only a half or 3rd of this sum, but still it must be some proportional part of his yearly income.

6. Tho' a man shall dy tomorrow after he enters into the Society his widow shall be entitled to her jointure and he shall be obliged to the first years payment provided a man enter into the Society within a year of his marriage or the first constitution of the Society but no man must be allowed to enter upon his death bed or when it is visible that he is dying to prevent which, it may be constituted that every man must not only come to transact this with the Directors but that the bargain shall not be finished till 3 months after the first proposal and the man be personally present.

7. But if he do not enter within a year of his marriage or constitution of the Society besides all other regulations concerning him must live a full year after he enters into the Society without which his widow shall not be entitled to her jointure.

8. A man is to be allowed to enter into the Society any year of his life but if he dont enter within a year of his marriage or the constitu-

tion of the Society he must besides his yearly payments advance to the Society a sum equal to all his payments supposing he had entered into the Society within a year after his marriage. But because this sum will be too great & equivalent to a total excluding great numbers out of the Society it may be considered whether any abatement may be made of this and what these abatements shall be.

To show that the Society has the best chance by people entering into it soon and not long after their marriage suppose 2 couple enter into the Society the one couple within a year of their marriage or about 30 & the other couple long after at 60 years of age & that they were both married in one year, the Society must be a much greater gainer by the one than the other for they gain of the one 30 years payments more than the other. But to balance this its said that as they have the chance of gaining then they have the chance too of losing 30 years payments to the widow which is not in the others case and after all if you allow old people to enter within a year after their marriage its the same thing. So this is dubious : or the question comes to this if you will allow men after a certain age 40 suppose to enter into the Society without a premium and what security the Society shall take to keep out old men that are dying.

9. The Society shall be constituted as soon as there are 20 adventurers.

10. every adventurer shall have an equal vote.

11. the management of the Society shall be in this manner

there shall be 30 Directors (7 to be a quorum-) their office to go by rotation according to their standing in the Society the Directors to change every year except the one half who shall continue 2 years, the Directors to keep books to ly open to all in the Society, the old Directors to clear accounts with the new : all the Society to have a meeting once a year upon a fixed day & nothing to be determined at that meeting as a rule that shall not be carried by two thirds or three fourths of the whole. the Directors to serve gratis and the Clerks Cashiers etc. only to be payed.

12. the Society at first must be voluntary and therefore there must be no compulsitor on any to continue his payments, but in case any man do not pay his annual sum within 6 months after it is due he shall forfeit all preceding payments and his widow to have no jointure : but the Society is to endeavour to obtain a charter from the Crown or act of Parliament as soon as possible.

13. No man nor his widow shall have it in his power to transfer his or her right to the jointure: to prevent stock jobbing.

14. If a man dy intestate and his widow marry her jointure shall be divided equally among his children, & she shall lose all title; but if he have no children the widow shall preserve a right to her jointure tho' she marry.

15. a man shall have it in his power by testament to proportion the widows jointure betwixt her and his children as he pleases, or to give it to the children alone and his testament shall be a rule to the Society.

16. When a mans wife dies he will doubtless discontinue his payments and if he marry again he must make a new bargain (if he would enter into the Society again) according to the above rules.

17. the Society is not to have a great capital stock but to depend chiefly on their annual payments and not upon rents of land or interests of money but as they must have some capital especially at first, the securing & disposing of this capital to be left to the Court of Directors.

18. the number of the Society not to be limited.

19. If one has once entered into the Society & is to pay so much & afterwards thinks it fit to pay more that his widow may get a greater jointure he must not be allowed to do this without a great premium.

APPENDIX II

There is in the records of the Fund a sheet of calculations with the title "Tables for the Widows Scheme 1743". There is a note in Wallace's handwriting "I think they were made by Mr. Colin Maclaurin"

The headings of the Tables give an indication of the nature of the calculations :

Table 1. Showing the Progress of the Fund according to the Doctrine of Chance. On supposition that Ministers now married or haveing children and those hereafter marrying pay for once a Double Tax and also that the 18 Widows left annually be of 50 years of age but the other provisions to be the same as in the Scheme.

Table 2. Showing the Progress of the fund on supposition that the Taxes on all Benefices are doubled the first year and on all those who marry for the first year of their marriage and that all children receive only half of the Provisions stated in the Scheme for the first 5 years and $\frac{3}{4}$ of the provisions for the next five years of the scheme and that the widows receive no annuity for the first year of their widowhood.

Note : The calculations showed that according to Table 1 the Fund might run into difficulty in the 21st year but that under the arrangement of Table 2 the Fund showuld be sufficient at all times.

APPENDIX III

*Letter of Colin Maclaurin to the Reverend Mr. Robert Wallace,
Moderator of the General Assembly of the Church of Scotland*

May 23, 1743

As you was pleased to mention my opinion concerning the scheme for providing an annuity to ministers widows and a stock for their children, in the committee of the general Assembly, I therefore thought it my duty to go over those computations again with care and lay the result fully before you to prevent mistakes of any kind. The design is so good that minute objections against the absolute perfection of the scheme or minute alterations seem to me to be improper, especially since it has been now so long under your consideration, and therefore I shall take notice only of what seems to me to be of importance and may easily be amended.

You was in the right, Sir, to represent me as a friend to the scheme in general. It must be advantageous to the body of ministers complexly taken because of the Tax on vacancies which I am confident on good grounds will amount to more than is supposed in the scheme. It must be advantageous on a second account to the widows and children of ministers because the annual tax is payable not only by those who shall leave a widow or children but likewise by those who shall leave neither. It must be advantageous because a greater improvement can be made of large sums and with less danger from the hazards to which all things are subjected by faithfull Trustees than of small annual sums by single ministers ; as it is a certain rule that no single man unless he be extremely rich, ought to deal in Insurance but rich men or companies of men only ; because loss to a poor man is more sensible than an equal gain. For these and other reasons too tedious to mention here I am of opinion that if this scheme take place and be faithfully executed as there is all the reason in the world to expect, it must be advantageous to the whole body of ministers and therefore if it be made equal it must be advantageous to every individual, those only expected who think they have no chance to leave a widow or child behind them. And as they must be few in number so they can only complain that they do for their brethren what they would have done for them if it had been their lot to have had their circumstances exchanged. The scheme is remarkably advantageous to the old and very few are so young as to have much reason to complain.

I was at a loss till Friday to know which scheme I was to compute, having already made several calculations that were rendered fruitless

by subsequent alterations. But now I am obliged to acknowledge that I find great reason to conclude that the capital of 50000L.St. will not advance so fast as is supposed in the calculations of the scheme. I am obliged to justify the Accomptant who appears to have carried them out with skill and care upon the principles given to him. But the mistake lyes in the manner of bringing up the number of widows. It is said that one of the widows dyes out of 17 but for the greater certainty one of 18 only is supposed to dye. Now it is certain that one cannot reasonably be expected to dye out of 18 till the age of 66 years, from registers that have been kept for a century of years of persons of 50 years of age one only dyes out of 31 yearly.

At first I did not imagine this would have so great an effect upon the progress of the Capital. I did observe to some Reverend ministers on Friday that it would retard its advancement considerably ; but on going through the computations with care, I now find that supposing the Tax and provisions to stand as in the latter Table of the scheme (wherein the Tax on those now married and that have children and those that afterwards shall marry is supposed to be doubled) the stock will arise in the 21st. year to 33070 : 00 : 09 but in the 22nd. year will advance only to 33133 : 07 : 00 which increase for that year is of 63 : 06 : 03 only. Therefore in order to add 200L.St. to the Stock this year an abatement must be made from the provisions for this 22nd. year.

This conclusion is founded on the supposition that the 18 widows who are left yearly may be reckoned to be of 50 years of age at a medium. If we pitch upon 47 or 48 as a proper medium the Stock will be at a stand sooner or in a less number of years and the abatements from the provisions will be necessary sooner. But if we take a higher number than 50 for a medium of their ages the abatements will not come so soon. It is true that if their number when full was at a medium 306 we might suppose 51 to be the just medium of their ages when they are left widows but since it is advanced Principles and Data page 6 that the widows are left one with another between the age of 45 and 50 I could not venture to take a higher number than 50 and since the number of widows at present is no more than 304 I did not think it necessary to take a higher number than 50.

If the stock come to a stand in the 22nd. year when it is more than 33100L.St. it is evident that the abatements on the provisions must be continued for a great number of years to allow it to rise to 50,000L.St. by the addition of 200L per annum only.

To prevent this and its disagreeable consequences may I presume to propose 1. that the first year's tax be double not only on those

ministers who are already married or have children but on all the benefices. 2. That the annuity be not payable to widows for the first year of their widowhood, because unless a minister at his death be in more debt to your fund than he can pay (which must be a rare case, and something surely must be left to your compassion and tenderness for one another) the ann may be supposed to afford as large a supply for the first year as the annuity for subsequent years. In like manner no annuity ought to be paid to the widows of such as bear offices in the Universities (tho' their successors may be taxed so as that there be no vacation of the tax) for the first year.

It is with reluctance that I propose this last but you will be pleased to observe that it is only one half year of annuity less than in the scheme and it is compensated by the benefit from the former article. I was the rather inclined to propose the first, because there is ground to suspect that 800 ministers which are supposed to be married or have children is too large a number : and if there be fewer in those circumstances the scheme will suffer by it. Besides to most of them it is only an anticipation of the time of payment that is proposed, I mean to such as are to marry.

I hope the liberty of proposing those things to you will be excused since it proceeds from a sincere concern for your success in so good a design and you can best judge whether these things are proper to be mentioned to the General Assembly.

I have begun the computation of the effect these articles would have on the scheme but have not had time to finish it. I have ground to think from what I have done that these (or any other equivalent to favour the rising of the capital) will in great measure answer the end.

What I have thought necessary to be represented to you on this occasion hinders not the scheme from being beneficial for the reasons above mentioned. It will be no difficult matter to satisfy any that are concerned that the computations are just right and I shall readily wait on any you will be pleased to appoint for that purpose. It is only in the progress of the number of widows that I differ from the scheme ; in everything else I retain the same numbers, I sincerely wish you success and am with the greatest regards

Your most obedient
Humble Servant
Colin Maclaurin

Coll. of Edinburgh
May 23, 1743.

P.S. The Table I have made of the number of widows and of the progress of the capital by which it appears to be stationary about the 22nd. year when no more than 31330L is ready to be produced.

For the satisfaction of such as desyre it I have copied on this leaf the number of widows in life entituled to the provisions according to the scheme and according to the Doctrine of chances (or Observations from Experience concerning the probabilities of Life) for some of the years.

Years of the Scheme	Widows in Life by the Scheme	Widows in life by the doctrine of chances, supposing them at a medium to be left at 50 years of age.
12	152.27	179.64
17	193	231.85
20	212.17	257.12
25	238	288.33
30	257.11	306.60

APPENDIX IV

*Letter from Colin Maclaurin 24th. May 1743 to
The Reverend Mr. Robert Wallace Minister of the Gospel at Edinburgh*

I kept no copies of the letters I wrote to you yesterday having been wholly employed in pursuing the calculations and revising them but want to have copies for which purpose please either to return them or get them copied for me by one of your sons today. As you have increased your capital to 55,000L (which by the by surprised me) and after all you have done it will hardly rise to 41,000 without making abatements necessary surely you ought to project some further remedy. The third article you and Mr. Webster would not allow me to mention was really more equitable than the first. You may think of it again in this shape, that for the first 4 years the children shall have only the half of the provisions stated in the scheme and for the next 4 years only three fourths of the same. If you think this a likely method I shall calculate its effect, I imagine you ought to have a probable scheme to show of the rising of the capital.

C. M. L.

May 24, 1743

I should be glad to have a copy today. I expect you will print nothing about my letters till I see it.

APPENDIX V

The following letter from Colin Maclaurin to Wallace is clearly a form of certificate intended for publication. From the wording of the letter it would appear that the Church had asked Maclaurin for his opinion :

Having considered the scheme for providing an annuity for minister's widows and a stock for their children laid before the late general Assembly the 12th. of May 1743 together with the alterations and amendments made upon the same by the genl. Assembly and my opinion being desired concerning the whole, I think myself obliged to say that the Design is so good that minute objections against the absolute perfection of the scheme seem to be improper after it has been so long under consideration and only observe that I have reason to be apprehensive that the capital will not rise so fast as is supposed in the scheme without deductions from the provisions proposed for the children. And as I am of the opinion that some deductions will be necessary in order that the proposed capital may be completed so it is most equitable that they should take place at the beginning of the scheme when they will have the greatest effect to promote the advancement of the capital and will require to be continued for a smaller number of years. The provisions however supposing these deductions to be allowed will be still abundantly advantageous. It is evident that this scheme must be advantageous to the Body of ministers taken complexely because of the tax on vacancies which I have reason to think will amount to more than is supposed in the scheme. It must be advantageous to the widows & children of ministers on a second account because the taxes are supposed to be payable not only by those who shall leave widows or children but likewise by such as shall leave neither. It must also be advantageous because a greater improvement may be made of large sums by faithfull Trustees and with less danger from the Hazards to which all things of this nature are subjected than of small annual sums by single ministers. For these and other reasons which it would be tedious to describe here at length I sincerely wish well to this design and cannot but be of opinion that if the scheme take place and be faithfully executed (as there is all the reason in the world to expect) it will prevent the unhappy circumstances to which ministers' widows and children are too often reduced. It is remarkably advantageous to those ministers who are advanced in

years and they only seem to have any ground to complain of it who think they have no chance to leave a widow or child behind them. But as these are few in number so it can only be said that they shall do for their Brethren what their Brethren must have done for them if it had been their lot to have had their circumstances exchanged.

Colin Maclaurin

College of Edinburgh

June 3, 1743

SYNOPSIS

The lecture describes how, in 1744, a fund to provide for the widows and children of the Ministers of the Church of Scotland and of the professors of the Scottish Universities came to be established and examines the calculations of an actuarial character on which its provisions were based. Some biographical details are given about the men chiefly responsible for setting up the fund, namely Rev. Robert Wallace, Rev. Alexander Webster and the mathematician Colin Maclaurin. Other work done by Wallace and Webster in the field of population statistics is also outlined.

DISCUSSION

The President:—I have no doubt from the reception how much we have all appreciated Mr. Dow's lecture. The meeting is now open for comments and discussion and, as I mentioned to our visitors, we would be delighted if they would take part if they wish. May I ask Mr. Donald to introduce the discussion.

Mr. D. W. A. Donald:—When we have a sessional meeting which takes the form of a lecture, we do not normally have a formal discussion, but rather a series of questions and answers. I am glad, Sir, that you have elevated me to a position to which I did not aspire because it enables me to exercise what, for the benefit of the visitors among us tonight, I should explain is the opener's prerogative, namely to congratulate the author on the work he has just presented, and this I sincerely do on behalf of us all.

Those of us who know Mr. Dow expected that we would have material put before us with scholarship, with grace and with wit; and we have not been disappointed. He has chosen a fascinating period of history in Edinburgh and he has brought to life for us three very diverse men. All three were concerned in the solution of a particular problem and, as I listened to his exposition, I found myself contrasting the abilities of those who managed to find practical answers to an obvious problem with those who have won our admiration by finding logically impeccable solutions to problems which, before their work, one might hardly have known to have existed. Of the latter, one may cite Pythagoras. His theorem and its proof are satisfying and beautiful to the mathematical mind, but one cannot help wondering how it was that he, or anyone else, came to consider the possibility that the square on the hypotenuse might be equal to the sum of the squares on the other two sides. Mr. Dow, tonight, has dealt with those in the first category. Speaking as one who, had he been a member of any widows' fund at any time since he became eligible, would have made a substantial contribution to its solvency, let alone its surplus, I cannot deny that it is, in the abstract, a good thing to provide for widows' pensions and, as an actuary, that there are considerable practical difficulties in making this provision. How then did the three men of whom we have been hearing tonight manage, with many fewer advantages than the modern actuary enjoys, to find so many by no means obvious answers to a problem which stared them in the face?

The abiding impression I formed from what Mr. Dow has been telling us is the part which the Ministry played in the community and the intellectual life of the community in Scotland in these days. It is in a way astonishing that men whom we might have thought of as impractical scholars, trained with a theological background, should have been, as Mr. Dow has said, such down-to-earth men. But there were others with a similar background. The minister at Inveresk, Alexander Carlyle, was a voluminous writer and in his autobiography he extols, as well he might, the contribution which the Scottish Church made to life in Scotland in the 1760's. He, as some of you may remember, was the minister who fell foul of the General Assembly by attending a public theatrical performance in Edinburgh. His sin was compounded by the fact that the play was written by another minister, and both—Hume and Carlyle—were rebuked for this. Carlyle's eulogy of the Church is contained in a series of rhetorical questions: "Who wrote a tragedy that has been deemed to be perfect? A clergyman of this church. Who was the most profound mathematician of the age he lived in? A

clergyman of this church. Who wrote the best treatise on agriculture? A clergyman of this church." He continues with other examples, but these will suffice to show the range and depth of knowledge which the Church had at its disposal. The problem which suggests itself to me here (which it is hardly fair to ask Mr. Dow to answer, though perhaps someone else here might) is how on earth did these ministers find time to do all this and simultaneously attend to their pastoral duties? They must have been men of immense industry and they must, I suspect, have had more time for thought than some of their successors today who are involved in a deal of committee work of one kind or another.

Mr. Dow gave us interesting examples of how the calculations turned out. I wonder if, possibly later on, without divulging any of the secrets of the fund which it would be improper for an actuary to reveal other than to the trustees, he could say whether the outcome has generally continued to be as successful as it was in the beginning. One other thing which I think might be interesting to some of us is to know when what I might call the investment policy of the fund changed. It is a fascinating idea, this compulsory loan at 4%. It certainly makes the actuaries' calculations a little easier than they are today, but how long was it possible to go on operating on this system? Again, I do not suppose it is still being applied today but it would be interesting to have that information.

And so, Sir, I end as I began by congratulating Mr. Dow on a thoroughly scholarly piece of research and a most fascinating start to our evening.

Mr. E. J. W. Dyson:—Thank you very much, Sir. We have had a most fascinating address. I listened enthralled the whole time.

I was very interested in the date to which these letters relate. In 1725, Abraham de Moivre had written a treatise on *Annuities on Lives or the Valuation of Annuities on Any Number of Lives, also Reversions*, which showed the necessity of bringing a rate of interest into the calculations. I wonder whether there is any evidence whether Maclaurin was aware of this. I am sure he was aware of the existence of de Moivre who is another of the giants of the time. It is also interesting that this fund was set up some generation before—some twenty-five years before—the London Society of Annuity and the Laudable Society of Annuity was set up in the 1760's. These were Funds really for the provision of deferred annuities to provide for people in old age rather than to provide widows' annuities and, to show what old age meant, the Laudable Society had a normal retiring age of 50. For those who entered after age 40, the retirement age was ten years after entry and the contribution was reduced. Like so many other of these early Funds, the Laudable Society was considerably underfunded and it became necessary for the annuity to be reduced. Nevertheless, the Society went on for several years before it was finally closed down.

Going back even earlier into history, the Church played a part (in England at any rate) as early as the fourteenth century in providing for pensioners. The monasteries, I understand, in those days used to sell for a cash sum as a single payment (not an annual payment) something called a "corrody" because it corroded and wasted away, by which for a cash payment a man or a man and his wife could take board and lodging in a monastery for the remainder of their lives and, even in those far off days, there was present one of the problems of annuity business which is still with us. Bishop Stapleton of Exeter was forced to order some of the monasteries in his Diocese not to grant any more corrodies because the terms on which they were granted were such that the annuitants were causing a "strain on the fund" due to their longevity being in excess of that assumed. Really,

indeed, these problems are always with us and I imagine they always will be.

Thank you very much, Sir, again for a most fascinating lecture.

The President:—I enjoy, as I am sure we all do, the occasional lecture given at Faculty Sessional Meetings in place of the usual prepared paper which is distributed in advance. With a lecture, the elements of curiosity and surprise remain very much alive and I know we have all been keenly interested to hear Mr. Dow's lecture tonight, not only for the pleasure of listening to him but also in anticipation of hearing something new about early actuarial work in eighteenth-century Scotland: we have certainly not been disappointed.

I have no doubt whatsoever that Mr. Dow's lecture will be referred to by future historians of actuarial science and that it will join the classics in that field. I think it is a classic lecture because, first, it has dealt with the very origins of our science and with three men who got engrossed in it so long ago. We must remember that the pioneers of actuarial science had no previous pathfinders to guide them and they did not have the sophisticated aids in the shape of mortality tables that we have now nor the functions we derive from them in conjunction with the theory of compound interest; although, having heard the figures given by Mr. Dow earlier, I am not really sure now whether it is an advantage to have these sophisticated aids. Second, Mr. Dow's lecture contained a flow of inspiration which has welled forth from the deep source of his own experience and sustained and replenished by his genuine love for actuarial science and from the curiosity which enabled him to perceive that in these early files there was a story well worth telling. And third, the nature and construction of the entire lecture showed all the earmarks of the craftsmanship we admire.

When I looked at the Appendices before the meeting, and as I was listening to Mr. Dow this evening, like Mr. Dow and Mr. Donald I could not help thinking how typical were the men he was speaking about of their place and time—of Edinburgh in the middle of the eighteenth century. What has been described as "A Golden Age", when Edinburgh, about one-eighth of the size it is now, was yet the leader in advanced thought and erudition in the world. We have had illustrated by Mr. Dow an example of men eminent in various fields reaching out into the fields of others. I have no doubt at all that the Rev. Robert Wallace and the Rev. Alexander Webster were very powerful preachers of the Gospel, yet here we see them venturing into the field of life contingencies. Perhaps they thought the pastures were greener there than their own! But I do not think that was their motivation, rather, they had the attribute of educated men of those days, of being prepared to participate in everything that went on around them, supremely confident that they could solve all problems by using their own disciplined minds. After all, minds accustomed to pondering the problems of immortality must surely have found the problems of mortality relatively simpler. There are other examples. There were published in Edinburgh around that time certain essays in human nature and philosophy which I would have thought perhaps might have emanated from one or other of the two reverend gentlemen we have been hearing about but, in fact, came from David Hume himself. There was that eminent judge, Lord Kaimes, who was also no mean practical agriculturalist (Mr. Donald referred to yet another agriculturalist of that time) and a theoretical philosopher; he produced essays on natural religion and these, I fear, so startled the clergymen of the Church of Scotland that they were withdrawn. And, of course, we know about Adam Smith and Craig, the architect of the New Town.

With Maclaurin, we are on more familiar ground. I can recall a feeling of pleasure—well, comparative pleasure—when I was studying what seems now to be known as numerical analysis (which I think was called in my day the calculus of observations) when I met Maclaurin in the company of certain foreign mathematicians such as Euler, Gauss, Bessel, Lagrange and Newton, and among these the name of Maclaurin had a warm Scottish quality. Hitherto, to me also, he had merely been the joint originator with Euler, of a very elegant practical mathematical formula, and one whose resting place I have noticed in Greyfriars Kirkyard; but now he is revealed to us by Mr. Dow as a very human personality with a close interest in life contingencies, expressing quietly, but firmly, his apprehension that the capital will not rise so fast as is supposed in the scheme: and that has quite a modern ring about it, too. I detect, too, a slight exasperation at several calculations rendered fruitless by subsequent alterations in the bases, and I wonder how many generations of actuaries in charge of actuarial departments have since then suffered like feelings. So he appears to me now as a very human personality—a man who wrote very penetrating letters to the Rev. Robert Wallace and yet evaded the rather humdrum task of keeping copies, but solving that problem very deftly by requesting, if not commanding, the Rev. Robert Wallace “to get them copied for me by one of your sons today”. Does that, I wonder, lift the veil a little on how men like these managed to find time to do so much in those days.

And, so, Ladies and Gentlemen, we are most grateful indeed to Mr. Dow for undertaking his research, for assembling the data, and for presenting it to us this evening in such a fascinating manner. I wonder now, Sir, if I may venture to put ourselves further in your debt and ask you if you have any comments on the remarks you have heard this evening.

Mr. J. B. Dow:—Thank you very much, Mr. President, for your kind remarks and the other gentlemen for their comments. I think I can reassure Mr. Donald about the continuing success of the widows' fund. I have not got the exact figures before me but I think while the contributions have remained the same the annuities are very nearly ten times what they were in Webster's day.

I think that's about right, Mr. Dunlop, is it?

(Mr. Dunlop:—The present payment is £222 per annum.)

I agree with him, too, about the ingenious device for lending the members money at 4 per cent. and what a lot of problems it solved. There is no evidence about this in the papers, but I think it is psychologically certain that this was a device of Webster's to get round the Assembly. I am sure he was very annoyed when the first scheme was turned down and the objection made was that the clergy would not be able to manage the investments. So he said, “All right. We will lend the clergy the money themselves and then there won't be any investment problem.” The practice was abandoned some years later (I'm sorry I can't quote the exact date from memory) but I think it probably foundered on the rock that clergymen were not the best people in the world when it comes to paying interest.

Mr. Dyson raised a very interesting question about de Moivre's paper on *Annuity Values*. So far as I have been able to discover (and this is a thing that interests me very much) there was no evidence in the calculations that have been preserved that either Wallace or Maclaurin at the time they did these calculations knew about de Moivre's work and certainly, as far as I can see, did not use it. All the calculations were done by accumulating retrospectively and building up the fund.

There was one earlier widows' fund, at least, established in 1697 by the

Mercers' Company of London. It was a single premium basis really ; you paid £100 and you got a certain annuity to your widow ; but the difficulty was that they had not appreciated that this should have varied with age and they had no provision for new members. It was not compulsory for anybody. It was hoped that the clergy would join but, in fact, they did not do so in very great numbers. The fund went bankrupt and had to appeal for Government assistance (since it was a London fund that was forthcoming!) and it struggled for a few years more but was eventually wound up. That, I think, was the first attempt on a commercial basis. The Church of Scotland's own first attempt, as I said, was in 1698.

And, finally, Sir, I agree with you entirely about Maclaurin. He was a most interesting character whom I am very glad to have met, as you might say. Unfortunately very little of his correspondence seems to have survived but there is another letter which he wrote to a friend of his about some bickerings which were going on at the University at that time, which is really a most charming letter by any standards at all, saying in effect simply, "I do wish they would all shut up and leave me in peace". I think these letters that are quoted here were to some extent written under, I won't say Webster's duress, but under his persuasion. You see, the other thing that the Assembly had objected to about the first scheme was that it did not give full benefits from the outset and Webster was quite sure that he would not get any scheme through the Assembly if it did not do that. So I think he must have slightly persuaded Maclaurin to play down his objections and said to him, "Let's get this scheme through and at the very first possible moment we will change it". That, I think, is the explanation of that phrase in one of the letters, "which you would not allow me to mention". In fact, the application forms were hardly in before Webster was writing to the evening paper of the day, which was *The Edinburgh Courant*, coming down very heavily on the older ministers because they had, quite reasonably it would seem to us, chosen to go for the bigger annuity and because the younger ministers were not joining at all. Well, if their salaries were less than £45 a year, could you really blame them? At any rate, he used that as the excuse for getting the Act changed immediately to what really was the original basis that Wallace and he had put up in 1742, and I am quite sure that in all that I am not being fanciful in seeing the hand of Webster. He was, what the Bible calls, a "Master of Assemblies" and he knew how to manipulate committees and make them do what he wanted to do. So I think that the scheme which went through in spite of the letters that Maclaurin wrote was really subject to the unwritten agreement "let's get this through now and we will put it right later on".

The President:—You have already shown earlier how much we have appreciated Mr. Dow's lecture and now may I ask you to join me and give him a hearty vote of thanks for the pleasure we have had this evening.

Mr. Dow later wrote :—I would like to answer Mr. Donald's questions more fully than I was able to do at the meeting.

The present position of the Church of Scotland Widows' Fund, as reported to the General Assembly in May 1972, showed that the net capital funds held by the Trustees at December 1971 were £3,069,959. The rate of widow's annuity for 1972 was, as quoted by Mr. Dunlop, £222. This figure applied to the widows of those members who joined the Church after 1929. The widows of those pre-1929 members who paid a contribution of three guineas (as fixed in 1814) received an annuity of £129. In other words, for an increase of 20 per cent. in the contributions which Wallace fixed in 1743

there has been an increase of 1290 per cent. in the annuity. This has not, of course, come entirely from the actuarial surpluses in the working of the fund. Over the centuries it has received many legacies and donations.

In answer to Mr. Donald's second question, the system of compulsory loans to members was ended by an Act of 1778 which superseded and repealed the acts of 1744 and 1748. It provided, *inter alia*, that "the loans of £30 to Ministers and Professors having proved hurtful to their families and the Fund" such loans should not be made in future and arrangements for repaying existing loans were laid down. How the loans had proved hurtful was not explained.

I am afraid that in my reply to Mr. Dyson the reference to the Mercers' Company fund was not wholly accurate. I have not personally investigated the history of this fund, but, according to Deuchar, it was started in 1699, not 1697 as I said, and, though basically by single premium, there was an option to pay by annual premiums ceasing at age 60. Falls in the rate of interest caused the benefits to be reduced on several occasions from 1717 onwards, and about the time the Church of Scotland was starting its scheme, government aid had to be sought and an annual grant from Parliament of £3,000 enabled it to meet its liabilities and clear off its arrears.

In my reply to the President I referred to a letter which Maclaurin wrote to a friend. Although it has nothing to do with the subject of this paper it deserves to be remembered by something better than my crude paraphrase. This is part of what Maclaurin wrote :

"Some folks prefer plotting and cabaling to airing on Swanstoun Hill or a silent walk in Woodhouslie wood. They have already begun and must have some part of their will. Let them have it since they will and much good do it them. I have no taste for contention especially now I am in great quiet."