

## DISCUSSION ON THE THIRD REPORT OF THE CONTINUOUS MORTALITY INVESTIGATION BUREAU

[Held at the Institute, 23 January 1978]

**Mr. E. A. Johnston:** I am here to represent the Steering Committee of the Continuous Mortality Investigation. Although the main document before the meeting is the Continuous Mortality Investigation Reports No. 3 I shall refer briefly to *CMIR* 2, which was published in 1976 and has not yet been discussed in Sessional Meeting: part of it is relevant tonight.

I should like to give a quick overview of the work of the Committee. *CMIR* 3 contains the results for the years 1971-74 inclusive of a number of experiences. First, the regular assured lives experience, that is male lives under whole life and endowment assurances issued in the United Kingdom. I have no special remarks to make on that investigation, but the committee would welcome any comments which the profession wishes to make.

There are also the first reports on three new investigations. The first relates to insured lives under policies issued in the Republic of Ireland, where (Table 8, p. 41) actual to expected ratios for the Irish experience are shown alongside similar ratios for the United Kingdom, and it is evident that the Irish mortality is somewhat heavier. It is intended to continue this investigation and further results will be reported in due course. The second new investigation is that of female assured lives under whole life and endowment policies issued in the United Kingdom. This particular experience is likely to be very relevant in modern conditions when we hear so much about male and female differences. The interesting conclusion which we have from the first set of data (Table 10, p. 44) is that the female mortality curve is not simply lighter than the male, it is actually a different shape. After a further 4 years' data have been collected, the Committee will try to construct a female assured lives' mortality table. The third new investigation relates to mortality under temporary assurances, level and decreasing policies being distinguished. This experience is limited to male lives under policies issued in the United Kingdom. The Committee hopes that these three investigations will become of increasing value to the profession as the volume of data increases. In the meantime, comments are welcomed.

A new investigation has also been started into lives under *linked* policies. There is no data available yet, the first period being 1975-78. The results will be included in the next report.

*CMIR* 3 also includes the 1971-74 cause of death experience for assured lives. We hope to further analyse annuitant mortality by cause of death, to continue some interesting research, the first instalment of which was presented at a Sessional Meeting in February 1976. *CMIR* 3 contains reports on the mortality for 1971-74 of immediate annuitants, of pensioners under life office schemes, and also of self-employed annuitants.

CMIR 2 included the first report on the experience under Permanent Health Policies. There are no further statistics available at the present time, but the Committee hope to be able to place a report before a Sessional Meeting in about a year's time.

We welcome any comments which the meeting may have on that programme as a whole, or any of the particular items in it. I will now turn to the main item of interest, the construction of standard tables of annuitants and life office pensioners. The need for standard tables has been recognised in the past, and the profession has prepared a succession of them, the most recent for annuitants being *a(55)*. In some respects, however, times have now changed. The almost universal use of computers makes it less necessary to publish extensive tables of life and commutation functions. It could be argued that many offices only need the basic mortality rates, or perhaps not even those. We have available, for anyone who requires it, a computer routine for deriving the mortality rates in the double-entry table described in the report. The reason for making this available is that it is simpler to put this program into a computer than it is to feed in the double-entry table itself. Certainly practical reasons do not limit offices to a single-entry table, as was the case in the 1950s. We did produce a double-entry table with the *a(55)*, but that was only an ancillary one. Now it can be the main tool.

It may also be argued that any actuary ought to consider the data—certainly his own data—and make his own judgment on what rates to use. He will have to decide on the degree of forecasting he wishes to incorporate in his own basis. However, the Committee feel that they should give firm guidance as to the interpretation of the fairly comprehensive data with which the offices have supplied them, and also we feel that we should give guidance on the degree of forecasting which should be allowed for, and moreover we feel that we should give this guidance in a directly usable form. All this indicates the preparation of a standard single-entry table.

In many cases, tables are being applied to groups of lives for whom no separate data exist. The actuary of a small office, for instance, may have no experience of his own. He may not have any grounds for making a particular decision about forecasting, so a standard table is essential. A single-entry one is probably more convenient for a number of uses. In my own field—which is that of Government—this is a frequent situation. Various Government authorities have to promulgate tables, for instance showing the capital element of purchased annuities. Under the proposed Life Assurance Liability Regulations, which includes pension and annuity business, the Secretary of State will be required to *recognize* specific mortality tables which will then constitute a *minimum valuation basis*. There again, he will need some guidance from the profession as to what tables he should recognize.

Mortality rates may be required for other calculations, the results of which impinge on legislation, but which need to be expressed as simply as possible. There is a need for both Government and others concerned with public policy to have available tables which represent the general experience of groups such as

annuitants or pensioners. Much the same could be said of the actuaries of many smaller offices, who may require a table which they can use simply, perhaps even by means of commutation columns.

At this stage a number of technical choices were available to the Committee. These are discussed in the report, but I will summarise them briefly. First, we were in little doubt that allowance should be made for future improvements in mortality. Given this decision, there was a choice between various methods of constructing a single entry table, and the Committee propose a table representing the rates which, on our hypothesis would be experienced in the calendar year 1990. Considering graduation, the formula which was put forward in *CMIR 2* was to graduate  $\log(q_x/p_x)$  by a polynomial. We followed that method, but for the standard tables the graduations based on linear polynomials have been used, although in the earlier tables one of the graduations put forward was based on a function of higher degree. Finally, the specific reduction factor proposed equates 20 years' improvement to an age rating of 1 year: so apparently we only age in 19 years out of every 20.

The Committee recommends that the table should not be used blindly: each actuary must consider its applicability to the particular group of lives under consideration, using what data he may have available. Ultimately the decision as to what basis should be adopted must be a personal one.

Regarding the applicability of the table in this paper to *in-service* lives under pension schemes, it must be borne in mind that every pension scheme is different. The rates of *in-service* mortality depend very much on the selective force of ill-health retirements. That in turn depends on the medical standards of the employer: if he is reducing the number of staff he may retire people on ill-health grounds who otherwise would not have gone. The report suggests that assured lives mortality may be suitable for that group. Apart from the variation between schemes, the experience in my office is that this is perhaps suitable up to age 50, but that it is only for higher ages that the rates are really significant, and there the *in-service* mortality is appreciably lighter than that of assured lives. Assured lives mortality would be safe for valuing death benefits; but it would be too light for valuing benefits payable on deferred retirement, or on retirement at normal pension age.

**Mr P. J. Turvey** (opening the discussion): It is two years since the Institute last discussed the work of the C.M.I., and four years since we discussed the A67/70 graduation, and 22 years since the previous discussion on the graduation of the A49/52 experience. The trend of the past four years represents an improvement over the previous period, and I trust that our discussions on the work of the C.M.I. will remain a regular feature of our future programme.

The most important aspect of the paper before us is the set of proposals for new standard tables for life office pensioners and annuitants, and most of my remarks will relate to these proposals.

A general point, which applies to all the experience sections of the report, is the question of the occurrence of years with exceptionally light, or exceptionally heavy, mortality. I feel intuitively that this could materially affect the observed trend. I hope that the Committee will be able to expand their comments in due course beyond the brief footnote in the section on cause of death.

For life office pensioners the trend of mortality levels is fairly clear, but this trend is nevertheless liable to be affected by factors other than secular reduction in mortality. In particular, the statistics published for pensioners retiring before normal pensionable age are particularly vulnerable to distortion if the distribution by duration since retirement changes over time. If, as I would expect, there is a negative selection effect from early retirement, a rapidly increasing in-force block of data coupled with a less rapidly increasing flow of new entrants—which appears to be the case—would show an entirely fallacious improvement in overall mortality as the experience matures. I would therefore ask the C.M.I. Committee to produce a select analysis for this group of lives, and exactly the same point holds for retirement annuities.

Turning to the problem of published tables, there are two main problems which must be tackled. The first concerns the difficulty of determining any basis for the extrapolation of future mortality rates in which we can have any real confidence, in view of (a) the somewhat erratic changes in population mortality (which, incidentally, differ according to geographic region); (b) the presumed secular changes in the constitution of the groups which we are considering with respect to socio-economic class and other factors, as well as (c) the very limited volume of experience data in some groups. The second main point is the need to produce a readily comprehensible and adequately accurate series of tables for use by practising actuaries.

I suggest that these twin aims cannot be met by a table based on one set of  $q_x$ , because this would imply that important decisions were being made by the compiler of the tables rather than by the actuary using them. The situation calls for tables which allow the actuary to select the underlying assumptions most appropriate to his own work. Taking as an example immediate annuitants, calculation of premium rates might warrant a *middle* assumption on mortality improvement, whereas valuation would call for a more *conservative* estimate. The actuary must have available some indication of the effect upon annuity rates of variation in the assumptions regarding secular improvement in mortality. It would be most helpful if the committee could produce some calculations illustrating this aspect, and perhaps investigate whether a simple rule-of-thumb adjustment could be developed to enable annuity rates on a range of assumptions to be developed from one set of published rates by use of an adjustment to the age at entry, or otherwise. Even if this can be done, we would still be faced with a multiplicity of tables for annuitants and pensioners, each subdivided into male and female. Would it be possible to find some suitable practical equivalent adjustments (to *age* or *rate of interest*) which would enable us to prepare rather fewer sets of tables, without sacrificing accuracy?

Turning to the actual tables to be published, the Committee has considered three methods of construction, all of which are based upon a single set of values for  $q_x$  projected to a certain date. In the first, the  $q$ 's are projected to an average year in which they will be used in practice, as in the  $a(55)$  tables. In the second, they are projected to the rate experienced by a cohort with a single year of birth; and in the third case, which was selected by the Committee, they are all projected to a given calendar year, in this case 1990. All three methods will give broadly comparable results, but will produce distortions at the edges.

In §38 of the Report, the Committee considers, and rejects, the idea of basing published tables upon a double entry mortality table, on the grounds that the volume of tables which would be required would be too large. I am not convinced that this is a problem, and believe it would be possible to produce a single set of tables of the same size as those proposed which would nevertheless achieve the desired effect. This can be achieved by using the 20-year repeating factor which is introduced by the graduation formula for projecting mortality rates. In essence, the values of annuities (or other functions) would be tabulated commencing in a given calendar year such as 1980. Each annuity value would be based upon the projected  $q_x$  for that age, so that the value of (say)  $q_{75}$  used to calculate  $a_{65}$  would be different from the value of  $q_{75}$  used to calculate  $a_{70}$ . The tables could be readily constructed by computer, and annuity values appropriate to annuities commencing in any year after 1980 would be obtained by taking a reduction in age of one-twentieth of a year for each year elapsed since 1980. Such values would readily be obtained by interpolation, an art with which most of us are familiar.

Some facility would need to be included to allow calculation of other functions such as annuities with a guaranteed period. Values of  $N_x$  and  $D_x$  would be meaningless and could not be used. But we could tabulate the functions  ${}_5E_x$  and  ${}_{10}E_x$  and perhaps  $(1a)_x$ . Alternatives would be to produce either

a set of twenty generation life tables giving values  $l_{[x]}$ , and  $l_x$  for twenty consecutive years of birth; or more simply, to produce triangular tables of  ${}_t p_{[x]}$  and  ${}_t p_x$  appropriate to 1980. Guaranteed annuities could then be obtained by using the ordinary relationship:  $a_{[x]} : \bar{a} = a_{\bar{a}} + v^t \cdot {}_t p_{[x]} \cdot a_{[x]+t}$  where  ${}_t p_{[x]}$  is based upon the value appropriate at the time of issue, and  $a_{[x]+t}$  is based upon the value of an annuity commencing in  $t$  years time—that is, with an additional age setback of  $t$ -twentieths of a year. Joint life annuities would be dealt with in an analogous way.

The majority of retirement annuity contracts are normally issued on a basis where the death risk is negligible, so that underwriting with regard to the proposer's state of health is relatively unimportant, and I assume that most, if not all, of this type will fall into the non-medical category. Contracts with some element of life cover are underwritten in the same way as whole-life and endowment assurance policies, and any comparison of mortality between medical and non-medical should be restricted to this group.

Turning now to the mortality experience of assured lives I welcome the publication of data relating to whole-life and endowment assurances issued to males in the Republic of Ireland, and to females in the United Kingdom, and for temporary assurances issued to males in the United Kingdom. I hope that this apparently blatant sex discrimination will not draw any unwelcome attention from the Equal Opportunities Commission, and trust that the missing parts of the jigsaw will be produced in due course; presumably the experience under temporary assurances issued to females in the Republic of Ireland will be the last to appear.

Considering what data has not been produced, I would like to see an analysis by *amounts* as well as *lives* in the same way as has been established for pensioners. I cannot anticipate the outcome, but I am confident that it would be extremely interesting. Would it be possible to extend the scope of the Continuous Mortality Investigation to include rates of termination by lapse or surrender? I anticipate that this factor will loom increasingly large in our thinking in the United Kingdom in the next decade and now is, perhaps, the time to start collating statistics.

It would be very helpful to have an indication of the range of variation in mortality rates between offices—both for assurances and annuities. Although contributing offices are able to compare their own experience with *all offices combined* this information could usefully be supplemented, and an indication of the range would be helpful in a number of ways.

Returning to the actual contents of the paper prepared on the occasion of the discussion of the 67/70 graduation (*J.I.A.* 101, 209), I took exception to the graduated select rates of mortality at ages 70 upwards, and I have now been able to discover whether or not my fears were justified. At duration 0, the aggregate  $A/E$  for the period 1967–74 combined at ages 70 and over is 98% (based upon 18 deaths) and it would appear that my fears were unfounded, although the volume of data is very low. At duration 1, however, the aggregate  $A/E$  for the same group is 150% based upon 60 deaths, which is statistically significant, and I feel obliged to repeat my warning that the A67/70 table probably understates select mortality in this area.

**Mr. S. P. L. Kennedy:** Referring to the investigation into the mortality of female lives assured, it appears that although we have been allowing a four-year deduction in age from male mortality, the allowance should in fact be six years. However, we are told that the shape of the female mortality curve is different from that of males.

The Report on the proposed standard tables for pensioners and annuitants has clarity of expression and the recommendations are of practical value. For instance, the twenty-year improvement factor is found to be equivalent to the deduction of one year from the age, which is helpful in day-to-day work and makes life much easier.

The message which comes over with particular clarity is that views differ as to the level of future improvements in mortality. The *Faculty* Mortality Research Group have suggested that two mortality forecasts should be used for life office pensioners, but the C.M.I. Committee in § 25 are against this proposal, because “the calculated mortality rates will be used primarily for the calculation of premium rates and valuation reserves”. This was a good reason in 1952, but I do not believe it is as valid today, for two reasons. Firstly, we can be much more sophisticated in our technical approach with the aid of the computer. Secondly, we need to adopt a more sophisticated approach because we are living in an age of much greater uncertainty.

Some of the factors may not, however, be obvious. As an example, consider the effect of the rate of interest on our mortality assumptions; the higher the rate, the less the significance of more distant changes in rates of mortality. Table 15 (pp. 18 and 19), which shows the calendar year in which  $a_x$  using calendar years is approximately equal to  $a_x$  using forecast tables, illustrates this well. Consider a male annuitant aged 55, select, entering in 1985; the equivalent calendar years at rates of interest of 0%, 5%, 10% and 15% are: 2002; 1998; 1995; and 1992, i.e. a span of 10 years. The assumption that 1990 is a suitable equivalent year to take for using in the 1980s is therefore more appropriate to the assumption of high interest rates, which may or may not be sustained. Furthermore, an escalating pension requires the use of a low valuation rate of interest even if rates of interest are high. Care needs to be taken regarding the assumptions made.

I accept the arguments that were put forward by Mr Johnston for a single table. I appreciate that it may be needed for statutory purposes and for quick reference but I think there are dangers, and we need to look at the effect of variations from the standard, or measure the effect of variations from our assumptions. The whole trend of actuarial thinking these days is more and more in the direction of measuring sensitivity to change. I should like, therefore, to join Mr Turvey in a plea for the use of double-entry mortality rates and, in particular, that there are at least three bases, which might be the *optimistic* and *pessimistic* ones, as suggested by the Faculty, and the single standard table. We really do not need a proliferation of commutation functions and factors, because of the availability of computers. At most we require a set of double-entry tables of mortality rates. We do, however, need to keep a check on pensioners' mortality rates, and I fear that a single table could lead to this point being overlooked.

**Mr J. C. McIntosh:** The paper of the Faculty of Actuaries Mortality Research Group was conceived some two years ago at a time when the Committee had produced 'The Graduation of Pensioners and of Annuitants Mortality Experience 1967-1970', but had no commitment to investigate the possibility of producing tables for use in financial calculations. We, as a group, were concerned that the shape of the mortality rates based on the pensioners' experience was markedly different from that of the tables commonly used in calculations. We decided to investigate the effects of using tables based upon that graduated experience, incorporating various possible forecast levels of mortality. Our intention was not to advocate one particular table rather than another, but to suggest to the profession the possible range within which we felt mortality levels were likely to change in the future, and to show the financial implications of this in the valuation of various funds. Although we were somewhat disappointed at the narrow range of the results, we are gratified to find that the thoughts of the C.M.I. Committee have now developed along similar lines, as set out in the first of their papers.

The centre of the dilemma in making forecasts of levels of pensioners mortality is set out in § 22 of the C.M.I. Committee's paper. Overall, since the middle/late 1950s the mortality of pensioners retiring at, or after, their normal retirement ages has lightened at a much faster rate than that of the United Kingdom population as a whole. This does not apply at the higher ages, however; in the 80s and 90s as may be seen from comparisons of the data in Tables 1 and 4 on pp. 3 and 5 of CMIR 3. Although the chosen level of improvement factors are initially around mid-way between those which have applied in the past to pensioners and the official future projections for the population as a whole, it will be seen from Table 11, on p. 10, that after the various adjustments have been made, the improvement factors inherent in the proposed tables lean in the direction of the lower rates of mortality change expected for the population. This has been borne out by the valuations we have made of the two model funds which appeared in the Research Group's paper, using the proposed PA(90) tables. Taking  $a(55)$  ultimate mortality as a standard, against which the other results are compared, we find that in valuing our insured model fund, the reserve increases only by 0.8% on the proposed PA(90) table. This is somewhat lower than the average of our *optimistic* and *pessimistic* basis valuations. The reserve for females is particularly close to the lower end of the range. It is obviously the case, given the nature of the proposed PA(90) table, that the reserves for vested pensioners are relatively higher than those for deferred pensioners, and the latter might be felt to require some adjustment when practical calculations are being made. The form of the proposed tables would make such an adjustment an easy matter.

The valuations of our non-insured fund are broadly similar in the results they produced. It is

necessary to alter the contribution rate in this fund to take account of the anticipated mortality levels and the reserves were only about 20% above the lower limit of the range bounded by the Research Group's *optimistic* and *pessimistic* assumptions.

**Mr R. D. Clarke:** I shall be considering the first of the reports viz. the proposed standard tables for life office pensioners and annuitants. There have been difficulties. The change in 1957 in the class of life entering the immediate annuitants' experience was one of these. Another was the change in the pensioners' experience resulting from the increase in works personnel over the years. The full effect of this latter change has not yet been felt, since it is only now that the survivors of works personnel pensioners are entering the age groups from 75 onwards in numbers that are at all significant. This inevitably complicates the derivation of projection factors from the experience, and the Committee was certainly wise to look at the experience based on *amounts* as well as on *lives*, and also to look at what has been happening in the general population.

Another complication affecting the male experience is that, whereas after the dramatic fall in death rates consequent upon the introduction of antibiotics in the 1940s, there appeared, over a considerable period, to be no substantial improvement in mortality at ages over 50. In more recent years the downward trend in the mortality at older age groups has been resumed. This has led the Committee to use a constant improvement factor for its projections instead of one which diminishes with age as in former tables. It is difficult to disagree with this decision, but I would have preferred that at the very old ages—say over 90—the 20-year improvement factor had been gradually increased until it had reached unity at age 100.

We have no evidence of an increase in the limit of human life and this means inevitably that at the extreme end of the table there should be no movement in the value of  $q_x$  with the passage of time. I am aware that the financial effect of such a modification as I am suggesting is minimal, or even infinitesimal, but the retention of .9 as a 20-year improvement factor throughout life has led to some peculiar results at extreme ages. These are apparent in Table 16 on pp. 20–22 where the male values of  $q_x$  for pensioners from age 105 onwards are lower than the female ones. Similar anomalies can be seen in Table 17 on pp. 23–25 in the values of both  $q_{[x]}$  and  $q_x$  for annuitants. This directly contradicts all the evidence we have regarding old age mortality, and the fact that the terminal age for women is at least 5 years higher than that for men. Moreover, if in the tables for pensioners we compare the values of  $q_x$  based on *amounts* with those based on *lives*, we find that at age 99 and upwards for men, and at age 93 and upwards for women, the values for *amounts* are actually higher than those for *lives*.

I am well aware that the financial effect of these anomalies is minimal, but I feel that statistical truth should not be abandoned for reasons of convenience and that adjustments in the formulae underlying Tables 16 and 17 might have been made in order to avoid results which fly in the face of known facts.

**Mr. R. H. Daw:** Table 10 of the Mortality of Assured Lives Report shows the ratios of actual to expected deaths for females calculated by the A 1967/70 table with age deductions of 6 and 4 years. These figures show that a constant deduction does not represent the mortality of female assured lives. For durations 2 and over within the age range 36–90, the two right-hand columns of Table 10 indicate that the appropriate deduction, i.e. one which would give an *A/E* ratio of 100, varies considerably with age. It commences below 4 years for the age group 36–40, increases to a maximum considerably in excess of 6 years for the age group 66–70, and then decreases to between 4 and 6 years for the age group 81–5.

An approximate estimate of this series of age deductions can be obtained by using the central ages of the groups and, say, the 6-year deduction column of Table 10. For each age group the value of  $q_x$  which makes the *A/E* ratio equal to 100 is determined. Subtracting the values of  $x$  corresponding to these  $q_x$ 's from the central age of each age group gives an estimate of the series of age deductions. I calculated these figures and then made a rough graphical graduation of them. The deductions I arrived at start at 1.0 for age group 36–40, increase to a maximum of 9.4 at ages 66–70 and then decrease to 4.2 at ages 86–90. (A table of the age deductions for quinquennial ages is appended.) I would suggest that a set of age deductions like these could be a useful way of producing a mortality table for female assured lives.

In a paper to the Royal Statistical Society (*J.R.S.S.*, A 124, 20) I studied the age deductions which

made male and female rates of mortality equal. This study covered many sets of population mortality data in a number of countries and over a long period of time. I came to the conclusion that these age deductions followed a consistent pattern and gave a useful comparison of male and female mortality rates, providing both rates were increasing with age. At the younger ages, say below 30-40, the age deduction was not an appropriate measure and could even become indeterminate if, for example, the female rate of mortality was less than that of males at any age.

I have also calculated the age deductions for E.L.T. No. 12, and for the pensioners mortality tables Peg 1967-70 (lives) (CMIR 2, 83). Those for ELT No. 12 are usually a little lower than my graduated age deductions for female assured lives, and those for pensioners for ages over 60 usually lie between the other two. It is perhaps relevant to note that on p. 43 of CMIR 3 it is stated that 'E.L.T. No. 12 appears to be the right shape' for female assured lives mortality.

These figures seem to confirm that it is not unreasonable to think that there is a fairly stable relationship between male and female life office mortality of comparable groups and I have suggested that use could be made of it. There is however a disadvantage in that the younger ages would need special treatment.

*Table of deductions from male age (x) to obtain the age (y) at which  $q_x$  for females equals  $q_x$  for males*

Male Age x	Age deduction (years)		Peg. 1967-70 (lives)
	Female assured lives data and A 1967-70 (durations 2 and over)	E.L.T. No. 12	
38	1.0	3.6	
43	2.7	2.9	
48	4.4	3.7	
53	6.0	5.0	
58	7.4	6.3	
63	8.6	7.1	10.0
68	9.4	7.1	8.7
73	8.4	6.0	7.5
78	7.0	4.6	6.3
83	5.6	3.5	5.1
88	4.2	2.7	3.8

**Mr H. A. R. Barnett:** Mr Johnston made a point about in-service mortality but I think that different offices and different funds have widely different experiences. I have experience with certain self-administered funds cases where an individual could have been retired through ill-health, but because of the different benefits available, he has been retained on the active staff until death. Where an employee is in ill-health but has a fairly imminent death risk, it is sometimes appropriate for him to remain in active service in order that his dependants will receive the larger death-in-service benefits. There are therefore selective influences operating in opposite directions. It does not necessarily follow that assured lives tables are inappropriate. What is important is that anyone using mortality tables for this purpose should first satisfy himself that the tables which he uses are appropriate to the particular experience.

In reply to Mr Turvey's remarks concerning annual trends, it has been the intention of the Committee to eliminate these short-term factors by presenting their experiences in quadrennial periods.

The comment in the cause of death paper was only made because the contributing offices receive detailed particulars from the Committee year by year. This, we hope, is some recompense for the effort involved in providing us with the data, but, nevertheless, if the profession requires more detailed comments on what has happened year by year, I am quite certain that the Committee would be prepared to consider providing this.



In due course the Committee will be approaching the offices, and possibly other users of the tables, to ascertain their requirements regarding which functions should be published. I doubt whether there would be any real demand for the type of double-entry tables proposed by Mr Turvey. In my experience offices like to be able to state that they are using such and such a table without specifying precisely which parts of the double-entry table they are actually making use of. Therefore I am of the opinion that most users would prefer single-entry tables even if it is necessary for the Committee to bring these up to date from time to time.

Mr Turvey also commented on assured lives select rates at duration 1. I think he has a point here, even though it is based on a comparatively small number of deaths. Nevertheless, I would suggest that the data at duration 1, more than at any other duration, is influenced by selective withdrawal, because I believe it is still the case that the highest rate of withdrawal from life assurance policies occurs at the end of the first year.

Mr Daw commented on female assured lives: I doubt whether the Committee would wish to produce a table based on the male table adjusted on the experience of only two calendar years. I imagine they would prefer to wait until they have many more years of experience rather than using a device for distorting a curve, which is demonstrably of the wrong shape, into the right shape.

**Mr A. G. Mills:** I should like to take up a point made by Mr Turvey, that we will see various promulgations of tables in due course of combinations of females, whether they come from Ireland or not, and whether they are assurance annuity or not. I should like to request that the Committee considers looking at linked assurance mortality in Ireland. It is my understanding that the mix of new business written over the past few years in Ireland is somewhat different from that in the United Kingdom, a much greater proportion of the Irish business being linked. Indeed, the mix of business is so different that whilst it is appropriate to have the main investigation based on the experience under whole-life and endowment assurance policies in the United Kingdom, with linked business regarded as a subsidiary investigation, it does not necessarily follow that the same pattern should be followed in respect of Ireland.

When linked business was introduced in Ireland, and with subsequent entries to the Irish market, companies tended to set much higher levels of minimum premiums for this business. In consequence there is an element of financial selection creeping into the classes of business, in that those who can only afford to take out policies at smaller premiums have no alternative but to effect whole-life or endowment assurance contracts and are not included in the linked business.

The mortality experience under business effected in Ireland is certainly heavier than it is for conventional business in the United Kingdom. It will be interesting to see, in due course, whether the same pattern also emerges for linked business effected in Ireland.

**Mr D. E. Fellows:** As Mr Johnston mentioned, the difference in mortality for death-in-service benefits as between one scheme and another can be considerable depending on each company's practice as regards early retirements. I recall a few years ago dealing with a large scheme involving several thousand lives, where for a number of years the claims had been running at between 80% and 90% of the premiums. Then the company entered a period during which the claims became considerably lighter, dropping to about 50% to 60% of the same premium scale. On investigation it appeared that the reason for the change was that there had been a very heavy redundancy programme and in the process a number of lives in ill-health had been removed from the experience. There are a number of other aspects to be considered in underwriting death-in-service benefits and, when dealing with a very large company, some indication of the claims experience should be obtained if possible.

There is another factor which could influence the cost of death-in-service benefits, and that is the growth of salary continuation schemes. Such schemes result in some employees being retained on the pay roll and remaining in service for death-in-service benefits, whereas prior to the introduction of a salary continuation scheme, such lives would have qualified for early retirement pensions. The result could be an increase in the cost of the death-in-service benefits. In my own company we have not, as yet, seen much evidence of this, but it is clearly a point to watch, particularly as the premium rates for such benefits have to be finely tuned in our highly competitive market.

Other speakers have referred to the differences between works and staff mortality. Such differences

persist into retirement, pensioners who have been involved in heavy industrial work usually showing heavier mortality than other lives. Reference has also been made to the growing influence of works personnel in the mortality data. Heavier weighting still could come through in the future, not least as a result of the *contracting-out* decisions taken by many large companies. Many works employees will in future be included in pension plans either for the first time, or for substantially improved benefit levels, often on the same basis as staff employees. The result could well be to inhibit any overall mortality improvement under schemes.

**Mr R. E. Hayward:** I have some observations concerning the PHI investigation. We on the staff of the C.M.I. have already suggested that there will shortly be information available. It will in fact be the experience of individual lives in 1972/75. We are also conducting an investigation into the experience of lives covered by group PHI schemes where an employer/employee relationship exists. The Committee are collecting information which could be used to throw some light on the problem of mortality before retirement.

The difficulty is that we know that many offices are writing group PHI business, but only about six or seven offices are submitting data. I should like to make an appeal on behalf of the Committee for more offices which are able to give censuses of policies in force to consider joining the investigation. It is possible that pension schemes which also have PHI schemes attached to them experience different in-service mortality from schemes that do not have a sickness benefit attached, but the Committee are currently collecting data which might throw some light on the matter.

I should like to draw the attention of offices to the very carefully considered warning which is printed at the beginning of the tables in *CMIR* 2. We believe that the probability of falling sick under a PHI policy, whether individual or group, is very selective, and that the select period is a long one. As a consequence of the rapid increase in the volume of business under these policies, our statistics show a fairly small number of claims, but we believe that there are a large number of claims which will come out in the course of the unfolding of the select period. Consequently, I should like to reiterate the warning that the observed rates of sickness may not be suitable for any particular purpose at the moment, although they will be in due course.

**Mr C. M. Stewart:** *CMIR* 1 began with a note on history and development. On p. 1 we read: "The first standard table prepared in Great Britain based upon an assured lives experience was the Seventeen Offices Table, which was published in 1843 and based on the combined experience of a group of offices up to 1837." The year 1837 is not without significance. Many members will be aware that it was in that year that registration of births, marriages and deaths in England and Wales became compulsory. Shortly afterwards, the statistics of deaths in the year 1841 were related to the numbers recorded in the 1841 census, and E.L.T. No. 1 was produced. Whether it saw the light of day before, or after, the Seventeen Offices Table was published in 1843, I do not know, but it is certainly true to say that the life offices in the United Kingdom, and their chief officers, were pioneers in the field of mortality investigation and in the preparation of life tables.

Considering the report before us, examination of policies issued in the Republic of Ireland represents a new and interesting development, and one which is well worth continuing. Mr Mills, responding to Mr Johnston's reference that linked business would be looked at by the committee in due course, gave them a very positive suggestion that within that investigation they might look especially at the experience in Ireland.

A number of speakers referred to the experience of female assured lives in the years 1971/74. The contributing offices, and the Committee are surely aware that the Equal Opportunities Commission exists to ensure that no greater discrimination is made between the terms of policies on offer to male and to female lives than can be justified by their respective mortality or sickness experiences. Mindful of the prospect of a female table being prepared in due course by the Committee, Mr Clarke finds it very difficult to accept projections for female annuitants which result, after age 100, in rates of mortality for females lives in excess of the corresponding rates for males.

I share Mr Barnett's view of the work by Mr Daw, which was aimed at showing how to arrive at a suitable table for females by making adjustments to the age in a life table for males. This is possible, but my view is that the Committee should not falter in its plans to produce a separate table for

females. Let us go out of our way to avoid any possibility of criticism, for example by the Equal Opportunities Commission.

No one other than Mr Johnston had any comment to make on the 1971/74 experience in respect of temporary assurances. What interests me on this subject is a report in the press of a study carried out by the Bureau Européen des Unions des Consommateurs which has discovered that premium rates for term assurances are much lower in the United Kingdom than on the Continent of Europe. This cannot affect citizens of those continental countries who must buy the local product, but foreign nationals are to be encouraged to take out contracts with British companies, and the study has been sent to the Commission in Brussels suggesting that they investigate the wide differences in insurance costs between member states of the E.E.C. I regard this as a very interesting development, the full significance of which lies outside the scope of this discussion, but we might note the fundamental difference between a life assurance industry examining selectively the mortality experienced by different classes of policy holders, and designing and pricing its products competitively as a consequence, and those industries on the Continent whose operations are tightly controlled and which are allowed to issue only a limited number of standard policies at standard premium rates, set at an extremely safe level by the controlling authorities. It will, in my view, be many years yet before the E.E.C. begins to consider what kind of life assurance market there is to be, but on my travels it has surprised me how many people regard the solution as being to produce a European life table on which standard premium rates will be based so that there will be no unfair competition, as they would see it, by price. Such a point of view seems to me to be the very antithesis of the philosophy which is reflected in the activities of our Joint Continuous Mortality Investigation Committee.

This brings me to the principal question before us this evening: do we find acceptable the Committee's recommendation that they should publish for general use in the 1980s their tables of mortality rates projected from 1967/70 to the year 1990 by the methods and bases described in *CMIR* 3, in particular do we agree with their conclusion that a 20-year improvement factor of about .9 would be appropriate? When it examined the experience for the years 1967/70 for life office pensioners, the Committee concluded that the data was too mixed, the various time trends not clearly understood, the distinction between lives and amounts unclear, and the experience did not fit the standard tables currently in use and that there was no very clear basis for forecasting. It concluded that new tables should be prepared reflecting the new experience, and the tables it produced were published in *CMIR* 2. Those from the graduation of the pensioners' experience were given the name Peg, and those from graduation of annuitants' experience were given the name aeg. They warned that those 1967/70 tables were not necessarily appropriate for calculating premiums or reserves because they made no explicit allowance for future improvements in mortality. There was no attempt to forecast what the mortality rate might be in the future, because to do so might lead those who would use the resulting tables to attribute to them a degree of reliability which they did not possess. The Committee promised, however, to pursue with urgency the search for a suitable way to prepare standard tables for general use in practice.

I see a distinction between an attempt to forecast what mortality rates seem most likely to be in 20 years' time and commending rates for use when advising life offices—although for some of us it is a rather different client—on the amount of the liabilities being accepted under pension and annuity contracts. In the first case we know that we shall be wrong in our forecast, and we view that prospect with some equanimity. In the second, we have uppermost in our minds the consequences for the institutions which we advise, if we are wrong. We must not delude ourselves that by endorsing the .9 improvement factor proposed unanimously by the Committee this will improve its chances of being borne out by events: we must be more realistic.

I regard it as indicative that the Committee holds much the same view as I do myself when it refers to its projected rates as providing for *possible* future improvements, not *probable* or *most likely*. Moreover, when considering the experience of the years 1971/74, which lends little support to the projected rates, it states frankly that provision for improvement is still justified on grounds of prudence. I would agree and so I presume would Mr Baker and Mr Graham who stated in their paper to the Faculty (*T.F.A.* 35, 490) that: "The valuation regulations should provide for improvement in annuitants' mortality to ensure so far as is practicable that all offices use the same standards". I am no longer in a position to assess the likelihood of the Committee's proposals receiving that accolade.

The comments by Mr Turvey and Mr Kennedy suggest that they would not welcome such a standardization. They would prefer more freedom to use and interpret the statistics and to derive their own valuation bases. Mr Johnston did point out that sometimes it is difficult to know what is the starting rate of mortality from which one is projecting, particularly in the case of small schemes, or schemes where the experience is not large enough to be significant.

On the 1971/74 experience of immediate annuitants, pensioners and 1956 Act retirement annuitants, I am somewhat disconcerted by the great variety of mortality rates that we have for, let us say, men when they get into their late 60s: there is a population mortality rate; there is—although we do not identify it—a mortality rate for industrial branch lives assured; there is a mortality rate for lives assured in the ordinary branch; there is a mortality rate for immediate annuitants; one for pensioners where the basis is lives, and a different one where the basis is amounts; and I think from what they say in the paper, lightest of all, there is a mortality rate for 1956 Act retirement annuitants. This is a great variety of rates for a single age group in the population. The range of variation I feel sure is not so great as it is in the premium rates of motor insurance policyholders according to their particular bonus situation. Nevertheless, there is a variation which is fairly wide and it means that when we are deriving a basis for any particular fund we have to try to identify, as best we can, what is the starting mortality situation from which we must make whatever projection we deem prudent. The Committee has tried to help us by making a suggestion.

On the mortality of those in pension schemes, Mr Johnston made the point which was taken up by Mr Fellows and Mr Hayward, that there is a very considerable variation in the in-service mortality of members of pension schemes. I would take that to mean that, here of all places, there is no possibility of anyone promulgating for general use a single mortality table which would please Mr Turvey and Mr Kennedy. Mr Hayward also mentioned that the Committee intends to produce something on PHI shortly. This has an impact on the mortality of those who remain in service.

I had hoped that I might be able to conclude by saying that the Committee had received a clear mandate from the meeting that its proposals were entirely acceptable to the profession. I do not think they have got quite that, but I do not think anyone was seriously opposed to the proposal to use an improvement factor of .9. Mr Clarke appeared to accept it even at the age extremities. Mr Kennedy and Mr Turvey did not really oppose it, although they would like to have more freedom and would prefer to have a table which did not take a cross section of the mortality forecast for the calendar year 1990, say something more like a cohort basis.

I do not feel able to do justice to Mr Turvey's remarks because they referred to a rather complex matter, but as I understand it, when valuating in 1978 or 1983 or 1985 he would take as his starting point the mortality projected to that year from the 1967/70 experience. The Committee, on the other hand, take the view that, for practical purposes, we might use the 1990 projected mortality rates. If I have understood Mr Turvey correctly, I think I would find his suggestion more acceptable if I was confident that between 1967/70 and the year in which he is calculating the amount of the company's liabilities the actual trend of mortality would be closely in line with the level of improvement adopted by the Committee. If the mortality trend over the years is not close to that in the Committee's projections, I would have thought that for practical purposes it would be preferable to use consistently the table based on 1990 projected rates rather than to use a starting figure which might not be close to the mortality actually being experienced in that year. I hope I have understood correctly Mr Turvey's proposal. If I thought that the rates projected to 1983 offered a good starting point for valuing reserves in 1983, I would find acceptable the use of the double-entry table based on the 1967/70 experience, but if that is not the case, as I expect it will not be, then on balance I prefer the Committee's proposal.

In my view, we have reason to be grateful to the Committee. It is not for their own benefit that they have submitted to us the recommendations which some of us would endorse this evening; it is for our benefit. The Committee is seeking to enable us to make a collective professional judgment, an important one, and one which has to be made. I hope that the discussion which has taken place will encourage them in the view that what they have proposed is acceptable to the majority of us here. I know that they will be visiting the Faculty shortly and putting the same questions, and I hope that at the end of the two sessions they will feel that they have a mandate from the profession to publish their proposed tables.

**The President (Mr C. M. O'Brien):** It is my pleasant duty to propose a vote of thanks to those who are responsible for the paper under discussion. What we are considering is a measuring stick, and I see no reason why such a measuring stick as is proposed should make it any the more difficult for me to assess premium rates or reserves for annuitants when I have first compared what experience there is against a standard. It is a different standard which is being proposed, it is a more up-to-date one, it is going to be a slightly different shape, but all have spoken of the need to use a tool of this sort with discretion. It is not a panacea or something which is suitable for everything, but it is a standard.

I agree very much with one thing which Mr Kennedy said and I also disagree with him about the same thing! He said that one of the prime concerns of an actuary is sensitivity to change. He is absolutely right in that. The Committee directly suggests that if anyone wants it, a double-entry table is available, together with a computer programme to use it. I think it is perfectly appropriate that we should have a single standard table on the one hand and in addition a double-entry set of rates which Mr Kennedy or Mr Turvey can use if he has a computer and the necessary finance.

It seems to me that there is a very practical need for a single table printed with some commutation tables, not only for the uses which Mr Johnston talked about, but for very practical ones of the actuary in a small office who wants to calculate some peculiar annuity—those peculiar annuities which still arise day by day, despite the best efforts of all our computers. In other words, the *one-off* calculation which has to be effected so often in practice. It seems to me that for this purpose printed tables, and printed commutation columns are still necessary.

Mr Stewart referred to the fact that he was not sure whether this meeting had fully endorsed the Committee's recommendation. I do not know what percentage of the audience has spoken, but my guess is that there is a silent majority for the Committee's recommendation. What I am quite sure is that there will be unanimous support for a vote of thanks to all those who have been involved in the work of this paper. The profession are very much in their debt, and that of the offices which produced the data.

**Mr A. D. Wilkie:** The Committee will need to consider the various suggestions about further investigations, such as linked lives in Ireland. I hope no one really wants an investigation into mortality experience of female lives under linked temporary assurances in Ireland, which I think would be the sixteenth investigation and I am sure will be the last to be done! The Committee will also look at the female investigation. I believe the right approach is to graduate the female data rather than to do special age adjustments. Where there is enough data collected, as is the case with annuitants, we have never used the female annuitants tables and then made age adjustments for the male annuitants, we have investigated them both in parallel.

It is worth examining the quality of data available under some of these different investigations. Obviously the assured lives investigation for male ordinary (United Kingdom) whole-life and endowment assurance is much the largest, but that for male pensioners is of the same order. There are about 90,000 and 60,000 deaths respectively in each quadrennium. The female annuitants' investigation is much bigger than the male annuitants investigation, which is really quite small. The Irish assured lives and the female assured lives look as if they are going to be of the same order, 4,000 deaths in a quadrennium—slightly smaller than for the female annuitants. There are problems in graduating investigations, when the numbers get too small. This can be linked to Mr Clarke's comments. The male annuitants data run out in the mid 90s so any rates which are produced from ages 105 to 114 are pure speculation: they are simply where the graduated curve ends. That they are higher than the female rates implies nothing whatever about what the Committee thinks the female mortality or male mortality is at those ages because we do not know the respective levels for mortality above age 100. We have not, in the past, collected the experience of individual ages above 99, anyway. So it is pure hypothesis from, probably, age 95 onwards. It is also a bit speculative for the male pensioners down to age 50. Although 50 is the lowest age for which there is any data, in fact there is very little data at that age, and the mortality of male pensioners who retire at a *normal retiring age* of 50 is probably abnormal. We do not know if they ought to be in the investigation anyway. It is appropriate to warn the profession, too, that the male pensioners, graduated mortality rate at age 50 is on the high side. It looks as if there are some early retirements included. The male pensioners rates are obviously far too high if a straight line is projected downwards. No one has mentioned whether rates for males at ages

20 to 50 are needed for widowers' benefits to female members of pension schemes. I am sure that those who set up mortality tables in a computer will say that it is more convenient to have these available for all ages from 0 to 120 so that they are all of the same length, and it is not necessary to make provision for extrapolation.

Mr Stewart brought in some thoughts about the E.E.C. So far as a joint investigation of assured lives throughout the E.E.C. is concerned, this surely must be of secondary importance to having a pooled assurance market in the E.E.C. There is undoubtedly differential mortality within the different regions of the United Kingdom. Scottish mortality is higher than English, and in what used to be the North Western County Boroughs mortality is higher than in Eastern Counties Rural Districts, to the extent of the worst being about 50% higher than the best. We do not investigate *assured lives'* experience in Britain differentially by region, partly because there is no easy way of preventing a resident of Salford or Strathclyde from using a convenience address in Norfolk. There is a difference with motor rates.

The main purpose of the meeting was to give the profession the opportunity to say what it thought the Committee should do regarding publishing pensioners and annuitants tables. The cost of publishing is high and there is no point in producing large numbers of printed volumes on a basis that offices do not require. The Committee will have to consider what to do about this: it may well be that the silent majority is of the opinion that what we have proposed is suitable. I am not as confident as the President that that is the case: it may be that the silent majority have not had sufficient opportunity to think adequately about it. Perhaps, when they have, they will write and say that they really require something different. The Committee will also secure the views of offices, both in respect of the mortality bases that should be used and in respect of the functions that should be produced.

I have some sympathy with Mr Turvey and Mr Kennedy in the idea of using a double-entry table. I think that we have produced a method of using a double-entry table that is not quite as bad as might appear. Rather than a 1990 calendar year table, which is exactly the same as the 1968 calendar year table with adjustment of 22/20ths in the age, it will be possible and not too difficult to produce, say, a 1925 year of birth table, and every other year of birth table is the same with an age adjustment.

So the double-entry table can be condensed to either a single year of experience table or a single year of birth table. Although the computer routine that will be made available produces an enormous table which stretches out to 100 ages and 100 years of birth, and fills up even quite large computers with numbers, you do not need them all, and can operate with something very much less. The adjustment of 1 year in every 20 is the same as a quarter year of age for every 5 years of date of birth, so it would be quite possible to group data in quinquennial years of birth and use quarter age adjustments. I do not think a double-entry table in practical use would be quite so appalling as it looks to begin with, except for joint life cases. For joint life cases with 100 years of birth for females and 100 years of birth for males in combination, with all the ages concerned and an appropriate range of rates of interest, I think we estimated that it would take about 100 volumes of the usual size to produce. So a single life table is a practical necessity; but actuaries have always had considerable freedom to apply their expertise in the manner which they deem most appropriate in the circumstances, with the exception of things which are statutorily laid down.