

SOME OBSERVATIONS ON LIFE REASSURANCE

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A NUMBER of papers have been submitted to the International Congresses of Actuaries on the subject of life reinsurance and full discussions have taken place at the Seventh, Eighth and Eleventh Congresses. Very little has been contributed to the *Journal*, and many years have elapsed since a paper was prepared on this subject.

HISTORY OF LIFE REASSURANCE

It is somewhat difficult to trace the history of life reinsurance from its inception, but it is clear from such records as are available that reinsurance has been transacted for at least a hundred years. In 1849 it appears that a Reinsurance Agreement was concluded between certain Scottish offices, which was followed in 1873 by a supplementary Agreement. A further Agreement between Scottish offices was made in 1887, which was in operation until 1900.

An investigation was made by a number of offices in the year 1856 of the maximum sum assured retained by each office, and it was found that most offices retained not more than £5000 on any one life, although in some cases the figure was as high as £10,000 or £15,000. One office with 2160 policies in force for a total sum assured of £1,332,000, which incurred in the year 1856 claims by death of £15,000 (the fund at 31 December 1856 being £264,000), retained up to £5000 on any one life. It appears that the retentions of the offices in those days were extremely high, and it may be presumed that this investigation was conducted with a view to a consideration of the need for reinsurance and a reduction of the maximum sums assured to be retained.

On page 96 of *J.I.A.* Vol. VIII (1859), there is an article entitled *The principles which should regulate the reinsurance of risks*, and a comment appears to the effect that at one time a proposition from one company to effect an assurance with another company was looked upon with coldness, if not with suspicion, and this seems to have been due in part to the frequency with which companies offered reinsurances to others without any intention of retaining any amount for their own account. In view of the increasing number of proposals for large sums assured the managers and actuaries of several offices (presumably English offices) had previously drawn up 'Regulations' to be observed in the transaction of reinsurance business, but there is no evidence that they were formally adopted. These 'Regulations' included a provision that a copy of the original policy should be endorsed with a guarantee, fully indemnifying the principal office to the extent of the sum reassured against all contingencies for which it might be liable, but there was a proviso that the reinsurer would not be liable for any share of bonus additions to the sum assured, other than that, if any, to be allotted in accordance with the rules of the reinsurer. It was provided that reinsurances could not be surrendered unless the principal policy had been surrendered.

The practice of endorsing a copy of the original policy was considered no longer necessary, in view of the revision of the stamp duty payable in respect of reassurances, and a new set of 'Regulations' was proposed in 1859, which would apply to direct policies issued in favour of the principal office. The following alterations in practice were suggested:

1. the principal office should not pay a lower rate of premium than it received, except by mutual consent;
2. the principal office should be entitled at any time to demand consideration for the surrender of reassurances, such consideration to be at the rate of 35% of the premiums paid;
3. with-profit policies should be reassured on a non-profit basis, using a table of non-profit premiums which were appended to the new regulations.

In *J.I.A.* Vol. XII, p. 1, an article dated 1864 appears, in which it was advocated that the better course would be to issue a policy only for such amount as the office could retain for its own account, leaving other offices to issue separate policies for the amounts they could retain. The following objections to reinsurance were given:

- (a) it may be necessary to pay the reinsurer a higher premium than that received from the assured;
- (b) in the event of surrender the reinsurer may pay a lower surrender value than that granted by the principal office;
- (c) bonus additions in the case of with-profit policies cannot be adjusted to avoid loss on that score.

From the angle of the reinsurer, it was suggested that large risks were underwritten in a much less careful way than ordinary business, and that whereas formerly offices made joint inquiries regarding large cases, the principal office alone collected evidence which might be less complete and not so satisfactory. The reinsurer consequently gave its acceptance reluctantly, or declined with just as much reluctance. Further, the issue of large policies tended to a monopoly which, it was argued, was against the common good. If each office issued a separate policy for its own retention, the business would be spread among the various companies, each of which would make the necessary inquiries and this, it was argued, was in the interests of insurance generally and was sound financial practice.

THE REASSURANCE AGREEMENT, 1900

In 1900 a Reassurance Agreement (which is still in operation to-day) was made between a large number of offices, setting out the rules governing reassurances, it being understood that variations in the arrangements applicable either to individual reassurances or to the business exchanged by any two offices can be made by mutual agreement. It provides that full information be given by the principal office regarding the risk, exhibiting previous papers, if required, as well as new reports, details of its retention as regards old and new assurances, and terms of acceptance of the new as well as previous proposals. It provides that no sub-reinsurance shall be effected without previous consent in writing by the principal office. If the first premium is

not paid within one month after acceptance of the reassurance, the principal office must obtain evidence of continued eligibility for assurance before accepting the premium from the assured. Any information coming to the knowledge of the reinsurer (referred to as the guaranteeing office) by reason of which it desires to withdraw its acceptance, may be furnished to the principal office together with a letter requesting such withdrawal, and the acceptance shall be void after one week or upon the withdrawal of the acceptance of the principal office, or the placing of the risk elsewhere, whichever shall first happen, unless the assurance shall have commenced in the meantime.

The 1900 Agreement provides that the reassurance contract shall be either:

(a) a guarantee endorsed on a copy of the principal policy (or of one of the policies issued); or

(b) a policy issued by the reinsurer which must be endorsed to the effect that it is a reassurance of a specified policy issued by the principal office.

In any case, if the premium payable is at the same rate as that of the principal assurance, the reassurance follows the terms and conditions of the principal policy, including surrender values and paid-up policy values. In the case of with-profit policies, the reinsurer follows the rate of bonus declared by the principal office. This system of reassurance will be referred to as the 'original premium method'.

As an alternative, the reassurance may be effected on the premium scale applicable to direct business accepted by the reinsurer, in which case the Agreement provides that the reassurance shall be subject to the surrender values, paid-up policy values and terms and conditions of the policy issued by the reinsurer, and any alteration or commutation shall likewise be made on the basis applicable to the policies issued by the reinsurer, except that licences, extra premiums, and adjustments for errors in age shall be according to the mode of the principal office. Should the non-forfeiture regulations result in a different date of lapse from that of the principal policy, the reinsurer shall hold the principal office covered, subject to payment of a proportionate premium according to the difference in time, or should the reverse position apply, the reinsurer shall pay a surrender value at the date of lapse. Nevertheless, the principal office may keep the reassurance in force by paying the reinsurer the full premiums if the premiums under the principal policy have not been paid, so long as the original assurance is in force. The principle is that the risk of the reinsurer ceases when the risk under the original policy ceases, and this applies whether the reassurance is effected at the rate of premium of the principal office or of that of the reinsurer. Nevertheless, the principal office has the right to surrender the reassurance, even while the original policy remains in force.

In the event of a reduction in sum assured, the reassurances must be reduced at least by the same proportion as the original assurance.

The reinsurer follows the principal office in the payment of claims, but is entitled to copies of claim papers and, on request, to inspect the original claim documents.

The rate of commission is set out in the Agreement, but this may be varied by mutual consent.

RETENTIONS

Before we consider other methods of reassurance in operation at the present time, reference should be made to the circumstances in which reassurance is needed and the problem of fixing the maximum amount to be retained by an office on any one life.

The profit or loss which arises from mortality depends not only upon the number of policies under which claims occur, as compared with the number of policies which may be expected to become claims, but upon the incidence of the claims with respect to the amount of the death strain at risk. The variations in mortality profit may arise from numerous causes.

Consider first the deviations which may occur in the death strain when a group of lives is assured for identical amounts. The actual death strain may be consistently different from that expected and this may be due to a process of selection. It may be that the group is drawn chiefly from persons in a particular occupation, whereas the basic mortality table comprises data from a wider distribution of occupations. The variation may be due to medical selection or to other influences, such as the advance of medical science causing a progressive decrease in rates of mortality. These variations involving a different general level of mortality are not such as to call for reassurance protection.

The occurrence of epidemics may result in substantial but temporary fluctuations in the experience, and at the present time a temporary increase in claims is caused by the war, although the general trend of mortality excluding war deaths is satisfactory. The general level of mortality in Great Britain fluctuates from year to year to an extent beyond the probable range of pure chance. These fluctuations no doubt arise from many causes apart from epidemics, and economic and weather conditions would seem to contribute to these fluctuations. It is well known that winter mortality is considerably heavier than summer mortality, so that the severity of the winter plays an important part in the general level of mortality in any particular year. Over a longer period than one year, such as a quinquennium, much of this fluctuation disappears. The results of the *Continuous Mortality Investigation: Assured Lives 1924-38*, *J.I.A.* Vol. LXXI, p. 259, give a clear indication that these fluctuations exceed those which can be explained by chance variations alone.

Such temporary fluctuations in a company's experience could be covered by means of reassurance, but the protection required would be for the excess of loss ratio, securing the payment of the amount by which the actual death strain exceeds the expected death strain or $(100 + K)\%$ thereof. Life reassurance as practised in this country at the present time is not arranged on these lines. Excess of loss ratio reinsurance is difficult, both in theory and in its practical development, but it may be of interest to mention that such a scheme is in operation on a national scale in Brazil.

Consider next the deviations which may occur in the death strain if the group of lives is assured for various amounts. A profit or loss from mortality would depend not only on the factors of which examples have been given, but upon the experience of the group according to sums assured. Suppose only one policy were effected for a very large amount and that policy became an early claim, it would be possible for that loss to endanger the solvency of

the fund. On the other hand, an excess of claims, within the bounds of chance variation, out of a number of moderately large policies may involve more loss than a claim on one exceptionally large policy. For example, the expected number of claims out of a group of £5000 policies might be twenty-five, while the actual number of claims might be thirty, representing excess claims of £25,000. One policy for £10,000 would not greatly impair the stability of the business, but as the number of such large policies increases the stability becomes more impaired, up to a point where the minimum stability is reached, after which further large policies improve the stability. Since in practice the number of large policies is not likely to reach quickly the point where the stability is improved, it becomes necessary to fix a maximum sum assured to be retained on any one life, the object being in the first place to safeguard the solvency of the fund and, secondly, to ensure that wide fluctuations in the amount of the death strain shall be eliminated so that a fairly consistent surplus may emerge at each valuation.

We are chiefly concerned with the elimination of the peak risks, as in the normal case it is to be assumed that the portfolio is a profitable one and the amount of reassurance given off must, therefore, be reduced to the minimum.

In practice the maximum retention is fixed in a rather arbitrary manner, having regard to the financial resources which are available, but if it were felt that some investigation were required, it is suggested that it would be sufficient to list the business in force in broad groups according to the sums assured, showing the number of policies in force in each group. The number of policies in force for the larger sums assured would be relatively few, and it should be possible to decide up to what figure there is a sufficient volume of business in force to yield an average over the intervaluation period. It is not necessary that the individual groups should yield a regular surplus from valuation to valuation, as in practice it is the whole portfolio that is required to produce a steady profit.

A further indication may be obtained by comparing the proposed maximum retention with the expected death strain, either for a year or for a quinquennium, and this leads to the suggestion that an office making an annual distribution of surplus may consider it advisable to adopt a rather lower maximum than a similar office making a quinquennial distribution.

Having fixed the maximum retention for any one life, an office may analyse its surplus and the mortality profit from time to time to ascertain to what extent large fluctuations are experienced, and, if so, whether they are due to the larger policies, and it may modify its maximum retention as regards new business in the light of the results of such investigations.

In the case of an office transacting only non-profit business, or if the non-profit business is kept in a separate fund, it is not so important that the surplus should emerge so evenly, and a somewhat higher amount may be retained, subject to adequate resources which the office is willing to use as a mortality fluctuation fund.

Opinion varies as to whether, and to what extent, a lower maximum should be retained on lives at the more advanced ages, and whether the retention should vary according to class of assurance. In the case of the more advanced ages some offices consider it wise to restrict the maximum retention because it is more difficult to select lives effectively than at the younger ages, and at the extreme ages the mortality data upon which the premiums are based are not sufficiently reliable. Others argue that there should be a volume

of business at such ages to form an average, but provided the correct rate of premium is charged for each risk the volume of business in any one class is not important, for the portfolio must be considered as a whole. In fixing the retention at the older ages it might be of interest to consider the idea that we should aim at retaining a constant expected strain per life, i.e. that the product of the rate of mortality and the amount at risk should not be greater for a life at an advanced age than the corresponding product for a younger life. As regards class of assurance, it may be that some offices restrict their retention on whole-life assurances and term assurances because reserves do not accumulate so rapidly as in the case of endowment assurances, or it may be that this is a counter-measure against possible anti-selection on the part of the proposer.

There are sometimes occasions when it is not easy to assess the risk under a proposal, and as a safeguard it may be advisable to limit the retention to a lower figure than the normal. While in this country most offices are sufficiently confident in underwriting to retain a normal amount on substandard lives, it may be mentioned that some companies abroad prefer to make special arrangements for the reassurance of such business.

In special cases, where insufficient experience has been obtained to demonstrate the validity of the mortality basis, it may be considered advisable to reassure a quota share of the business accepted, so that the retention will be a certain percentage of each proposal, up to an agreed maximum amount for each life. There are few occasions in this country when such a course is necessary, but it may apply when an office is developing business in a new territory. It is used abroad for reassurance of substandard business and also for standard business when the reinsurer is helping to finance the new business strain. Reference will be made to this point in a later section.

It is possible to study the problems arising from mortality fluctuation by means of statistical theory, and a paper on this subject, by a member of this Institute who is more familiar with this intricate matter than the author, would be helpful. Various papers on the theory of risk have been submitted at the meetings of the International Congresses of Actuaries, and an interesting paper by Robert Henderson, entitled *Note on Limit of Risk* appears in Vol. ix of the *Transactions of the Actuarial Society of America*.

FACULTATIVE METHOD OF REASSURANCE

In this country the greater part of life reassurance business is still transacted facultatively, i.e. the offer of each reassurance is made by the principal office to the reinsurer, and the latter has the option of accepting or declining the business. It is usual to make the offer on the original premium basis and the commission paid by the reinsurer is usually the same commission as is paid to the agent. Consequently, no contribution is made by the reinsurer to the overhead expenses involved in securing the business.

This method has been described in some detail in an earlier section of this paper. It is assumed in that section that the reassurance is either placed on the original premium basis or on the terms required by the reinsurer for an assurance of the same class as the original policy. Reassurances may also be placed facultatively on the risk premium basis or on such terms as may be mutually agreed.

TREATY METHOD OF REASSURANCE

During the last twenty-five years there have been various developments in the practice of life reassurance in this country, and one of these is the automatic method of reassurance by means of a treaty.

The treaty specifies the business to which it is applicable, for it may relate to the whole of the business accepted by the ceding company, or it may be restricted to a certain class. For example, separate treaties may be arranged to cover standard and substandard business, or a treaty may relate only to the business transacted under a particular tariff.

The ceding company binds itself to offer and the reinsurer agrees to accept all surplus risks of the class described in the treaty in excess of the retention of the ceding company. Reassurance is therefore automatic following the acceptance of the ceding company. If the ceding company reduces its retention on any one risk the automatic cover is correspondingly reduced.

The treaty sets out the terms on which the business is to be reassured, whether on the original premium basis or on the risk premium basis, and the scales of premiums and commissions are indicated. Each cession is evidenced by the completion, in duplicate, of a simple statement (usually called a 'Definite Certificate') signed on behalf of each office, one copy being held by each office. This statement gives the particulars of the cession, and in addition the reinsurer receives a copy of the proposal papers, which enables some measure of control to be exercised. While the reinsurer is bound to accept the cessions made, the study of the papers enables an opinion of the desirability of the business to be formed, and, if any difference in underwriting standards emerges, discussions may take place on specific points which may result in a change of practice on the part of the ceding company. Should a study of the proposal papers reveal that the ceding company's methods are unsatisfactory, the treaty may be cancelled as regards new business before the portfolio grows to any large extent. In practice, however, this rarely occurs as the reinsurer is normally satisfied with the soundness of the company's methods before granting automatic cover.

When a treaty is on the original premium basis, the commission granted is normally in excess of the commission payable for facultative business, and represents a proportion of the overhead expenses in addition to the commission payable to the agent.

The treaty provides for the treatment of alterations, reductions, revivals, etc., as well as the furnishing of renewal lists and the settlement of accounts, which are usually on a quarterly basis. Claims in excess of an agreed figure are payable on receipt of copy papers, but smaller claims are debited in account.

There is an arbitration clause, and alterations to the treaty are usually made by addenda which are attached to the treaty and regarded as a part thereof.

Notice of cancellation as regards new business may be given by either party, but it is provided that existing business remains in force until natural expiration. Except where special arrangements are made under the risk premium basis, the reinsurer assumes risk with the ceding company and remains on the risk concurrently with the ceding company and there is no option to discontinue reassurances, as is the case in the Reassurance Agreement, 1900.

While a treaty usually provides obligatory cover there are occasions when a treaty is concluded on a facultative basis, in which case the reinsurer would undertake to notify its decision within a specified time after receipt of a copy of the proposal papers. In the case of a treaty for substandard risks where the papers are sent to the reinsurer for rating, the reinsurer has the option of accepting a reinsurance on its own terms or of declining the business.

RISK PREMIUM METHOD

The most popular method of reinsurance in this country is still to share the original policy so that the reinsurer receives a proportion of the premium charged by the principal office, assumes a pro rata share of all liabilities and consequently shares profits or losses from mortality, interest, loadings, surrenders and miscellaneous sources. Nevertheless, the most important reason for reinsurance is the limitation of the mortality risk on any one life, and in recent years the risk premium method has emerged, by means of which that risk alone is covered.

The ceding company accumulates the reserves for the whole policy, and the difference between the sum assured and the reserve is the amount at risk. Under the risk premium method the ceding office retains a portion of the amount at risk in accordance with its retention limit, and the balance is reinsured. The exact way in which the amount at risk in each year of the reinsurance is calculated depends upon the requirements of the ceding office, for the risk premium method is very elastic. For example, it is usual for the ceding office to retain a pro rata share of the mortality risk under the original policy, so that the amount at risk under the reinsurance decreases over the term of the original policy by the reserves relating to the initial sum reinsured. On the other hand, the ceding office may prefer to retain a constant amount at risk, so that in the event of a claim the net death strain will always be equal to its retention limit. Should this method be adopted, the amounts at risk covered by the reinsurer would decrease each year by the reserves in respect of the whole policy, and consequently the reinsurer would not necessarily be on the risk for the whole duration of the assurance. Alternatively, there may be an arbitrary decrease in the amount at risk over a period of years mutually agreed at the outset of the reinsurance. Suppose an office has an existing assurance on its books maturing at a fairly early date, say at the end of the next five years, and a further policy is issued which could otherwise be wholly retained by the principal office, the cover required is only in respect of the amount at risk under the existing assurance. A risk premium reinsurance can therefore be arranged to cover the risk for the five-year period and the whole of the risk under the new policy may be retained by the ceding office thereafter.

The reinsurance premium is calculated by applying the rate of risk premium for the age at the beginning of the policy year to the amount at risk for that year.

The net risk premium rates may be calculated by the formula

$$v^{\frac{1}{2}}q_x,$$

and the gross risk premiums should include a margin for mortality fluctuation as well as a loading for expenses and profit.

For example, we may adopt a formula

$$\frac{v^{\frac{1}{2}}q_x + c}{1 - k},$$

and it may be of interest to compare this formula with that used in calculating the office premium for the original assurance, which may be

$$\frac{\left(\pi + \frac{K}{a} + c'\right)}{1 - k'}.$$

Since the risk premium is applied to the amount at risk, the benefit the reassurer receives each year from c is a reducing item, whereas since c' is applied to the sum assured this item is constant. Hence, if c' is regarded as the mortality fluctuation margin, c should be greater than c' . Similarly, since k is a percentage of a risk premium, and k' is a percentage of a full office premium for a whole-life or endowment assurance, k may be as much as four times the portion of k' which relates to expenses (for k' will include renewal commission, which might not apply to the risk premium reinsurance).

As an example of the operation of the risk premium basis, let it be assumed that the risk premium is calculated by the formula

$$\frac{100v^{\frac{1}{2}}q_x + \cdot 25}{\cdot 9},$$

and that the office premium is £4. 15s. % for a 20-year endowment assurance on a life aged 40 at entry. It is assumed that a net rate of interest of $2\frac{1}{4}\%$ will be earned, and $v^{\frac{1}{2}}$ is therefore calculated at that rate, q_x being based on the A 1924-29 ultimate table. The sum assured is taken as £1000 and it is assumed that the whole policy is reassured.

Table 1 shows the rates of risk premium calculated on this basis, and the reserves calculated on the A 1924-29 $2\frac{1}{4}\%$ basis after making a deduction to allow for expenses of 2% of the sum assured. The amount at risk is calculated by deducting the adjusted reserve from the sum assured, and the reinsurance premium shown in the last column is obtained by applying the rate of risk premium to the amount at risk for the policy year.

Table 2 shows how the fund remaining in the possession of the ceding company is built up. The balance of the office premium after deduction of 2% of the sum assured in the first year and $2\frac{1}{2}\%$ of renewal premiums is shown, and in the next column the amount remaining each year after deduction of the reinsurance premium. These balances are accumulated at $2\frac{1}{4}\%$ per annum. It is assumed that the reassurer pays a commission of 50% in the first year as allowance for selection. The accumulated fund is shown to be slightly in excess of the adjusted reserve.

In theory the accumulated fund should be sufficient to pay the sum assured at maturity, but if the original policy is surrendered the fund should be sufficiently large to allow a reasonable surrender profit to be made by the ceding office after payment of the surrender value.

The figures do not include any allowance for the overhead expenses of the principal office, except in so far as the commission paid in the first year may be less than 2% of the sum assured. They enable a comparison to be

made with a facultative reassurance on the original premium basis, since no expenses would be recovered by the principal office under that method.

The treatment of substandard risks on the risk premium basis requires special consideration, for it is essential that the premiums received in the early years should provide adequate compensation for the extra risk incurred. Certain types of substandard risks may be dealt with by a rating-up of the age or by a percentage addition to the risk premium. If a debt is imposed the reassurer should benefit to the extent of its due proportion, based, of

Table 1. Example of risk premium reassurance in respect of a 20-year endowment assurance for £1000 on a life aged 40 at entry

Policy year	Age	Risk premium rate %	Reserve	Amount at risk	Reassurance premium
1	40	.704	£ 21	£ 979	*6.89
2	41	.732	62	938	6.87
3	42	.760	104	896	6.81
4	43	.790	147	853	6.74
5	44	.822	192	808	6.64
6	45	.857	237	763	6.54
7	46	.896	283	717	6.42
8	47	.941	330	670	6.30
9	48	.993	378	622	6.18
10	49	1.051	428	572	6.01
11	50	1.117	478	522	5.83
12	51	1.191	530	470	5.60
13	52	1.273	583	417	5.31
14	53	1.366	637	363	4.96
15	54	1.469	693	307	4.51
16	55	1.585	750	250	3.96
17	56	1.718	809	191	3.28
18	57	1.871	870	130	2.43
19	58	2.045	934	66	1.35
20	59	2.237	1000	—	—

* Less 50% as allowance for selection.

Risk premium rate per £100 = $\frac{100v^{\frac{1}{2}}q_w + .25}{.9}$, by the A 1924-29 ultimate table.

Reserve = $1000 \cdot V_{z\overline{n}|} - 20(1 - V_{z\overline{n}|})$, i.e. the net premium reserve after allowing for the amortization of the initial commission of £20.

Amount at risk = $1000(1 - v_{z\overline{n}|}) + 20(1 - v_{z\overline{n}|})$.

course, on the nominal sum reassured and not on the amount at risk. If a level extra premium is imposed, the reassurer will receive a pro rata share, provided the reassurance decreases by its own reserves; but if the office elects to retain a constant amount at risk, the reassurer is only entitled to a decreasing extra premium calculated each year by multiplying the extra premium (based on the initial sum reassured) by the ratio of the amount at risk to the amount which would have been at risk had the reassurance been decreased each year by its own reserves. The ratio is expressed as follows:

$$\frac{S - SV - R}{(S - R)(1 - V)}$$

where S=sum assured by the policy, R=the retention by the principal office, and V=reserve per unit sum assured for that policy year.

It is an interesting problem to consider what the reinsurer should receive by way of premiums when such a policy is converted to a paid-up assurance, and a consideration of this matter may lead to the conclusion that the method of charging a level extra is not so well suited as a rating-up in years

Table 2. Calculation of the fund remaining with the ceding company, assuming annual premium £47. 10s., initial expenses £20, renewal commission $2\frac{1}{2}\%$, interest $2\frac{1}{4}\%$ net

Year	Premium less commission	Balance after payment of reinsurance premium	Accumulated fund at end of year @ $2\frac{1}{4}\%$	Reserve
	£	£	£	£
1	27.50	24.05	24.59	21
2	46.31	39.44	65.47	62
3	46.31	39.50	107.33	104
4	46.31	39.57	150.21	147
5	46.31	39.67	194.15	192
6	46.31	39.77	239.18	237
7	46.31	39.89	285.35	283
8	46.31	40.01	332.68	330
9	46.31	40.13	381.20	378
10	46.31	40.30	430.98	428
11	46.31	40.48	482.07	478
12	46.31	40.71	534.54	530
13	46.31	41.00	588.49	583
14	46.31	41.35	644.01	637
15	46.31	41.80	701.24	693
16	46.31	42.35	760.32	750
17	46.31	43.03	821.43	809
18	46.31	43.88	884.78	870
19	46.31	44.96	950.66	934
20	46.31	46.31	1019.40	1000

or the application of a percentage mortality loading. In practice the level extra premium is no longer paid in such circumstances, but the reinsurer receives the risk premium as for a standard life. As the amount at risk is usually very small when a policy is converted to a paid-up assurance, it is frequently decided to cancel the reinsurance as from the date of conversion.

The risk premium reinsurance is, in effect, a renewable term policy, under which the reinsurer has no right to withdraw the cover while the original policy is in force unless it is arranged at the outset that the cover is only for a certain period, and similarly it is understood that the ceding company will not exercise selection against the reinsurer by withdrawing any or all such reassurances before their natural expiration.

As the premiums under a risk premium reinsurance are relatively small they are paid annually, and in the event of cancellation a proportion of the annual premium is refunded corresponding to the premium not received by the ceding office during the current policy year.

The risk premium method was discussed at the Eighth International Congress, and a full description of the method was given in a paper by

W. H. Clough. Other papers show how this method has been developed in a number of countries, especially in America and Scandinavia.

COMMENTS ON THE METHODS DESCRIBED

(a) The facultative and obligatory methods

The facultative method has the advantage that each office retains freedom of action. Any profit or loss incurred in effecting reassurances may be offset by a corresponding profit or loss on reassurances accepted, and if equal volumes of similar business are exchanged it should be to the mutual advantage of both offices, provided such business is transacted on sound lines. A disadvantage is that each case must be offered separately and all matters relating to each reassurance are dealt with individually, thus involving delay in acceptance, extra work and expense. It is usual for the reassurer to pay only its share of the agent's commission, no addition being made for overhead expenses. The obligatory treaty method saves time and expense, the acceptance being issued with the same speed as for a proposal within the retention limit of the ceding office, and the commission terms would be higher than those granted for facultative reassurance, thus allowing the ceding office at least some offset to overhead expenses. It may be argued that reassurances should be placed on terms which are self-supporting, for, while it is reasonable for the reassurer to follow the fortune of the ceding office as regards mortality and other profits, it is not reasonable that the reassurer should receive the benefit of the organization for the procurement of new business without sharing in its costs. The obligatory treaty aims at the transaction of business with due allowance in its terms for such costs, and this is possible because the reassurer receives a share of all business exceeding the retention of the ceding office. When business is reassured facultatively the reassurer might be subject to a form of anti-selection in that it may not always be the first office to receive the offer of the business. Suppose, for example, an office made a practice of offering all its reassurances to Office A, and in the event of declinature to Office B. Then the business offered to Office B would be subject to anti-selection, but Office A would be in an even better position than if it had concluded an obligatory treaty.

The terms which may be granted for reassurance by obligatory treaty depend not only on the premium scale, but also on the quality of the business likely to be ceded. This may depend upon the retention limit of the ceding office. Consider, for example, the extreme case of a small but active office with a modest limit. A substantial volume of reassurances would be ceded which would be advantageous to the reassurer, and in consideration of such business the most favourable commission terms would be granted, subject to satisfactory premiums. The obligatory treaty would be in the interest of the ceding office in that it would be able to transact business in excess of its retention limit with the same ease as though this limit were greater, and the commission terms would be such as to enable it to finance the new business strain. In comparing this method with the facultative method, it would have to decide whether it was likely under the latter to receive such a flow of business in exchange as would provide equivalent compensation for the loss of the improved commission terms, bearing in mind the additional work

involved. An alternative would be automatic cover for such an amount as would leave a few surplus risks to be placed facultatively.

Consider, on the other hand, an offer of an automatic treaty in the case of an office with a very large retention limit. The number of reassurances likely to be ceded under such an arrangement would be few, and the cover required would probably be large. The quality of the business might not be so attractive as in the case of the smaller office, for while the big office might have a highly trained staff to deal with the procurement and selection of business, the larger assurances contain inherent characteristics which might affect the experience. It is true to say that over-insurance is not common in this country, but it is possible that large assurances are subject to moral hazard. In order that such anti-selection should be eliminated as far as possible, it is desirable that such proposals should be investigated carefully, so that the underwriter may know the full circumstances, including the reason for which the assurance is required and the financial standing of the proposer. On the one hand, it is possible that lives effecting large assurances may suffer from an excess of the good things of life (rationing has had a beneficial effect on the health of such lives), and, on the other hand, in the event of illness there is the advantage that excellent medical attention will be available.

On the whole, therefore, the reassurer would not view such a treaty with the same favour as a treaty with the smaller office, but it should be added that no statistics appear to have been published to demonstrate that lives assured in this country for large amounts are subject to mortality greatly in excess of that experienced by assured lives generally.

The facultative method is easy to work in this country by virtue of the fact that so many head-office organizations are situated in London or Edinburgh, but where there are geographical factors making contact with other offices difficult, the automatic treaty is particularly useful.

The principal office, therefore, has to decide whether the convenience of the automatic cover and the improved commission terms which can be arranged for a treaty are more valuable than the freedom which it can exercise under the facultative method, bearing in mind the reciprocity it may secure from the office accepting the business. The automatic treaty on the risk premium basis has not been discussed, but here it should be sufficient to say that no advantage by way of commission terms arises. It is a question of considering the advantage of the automatic cover, coupled with the advantages or disadvantages of the risk premium method, compared with the original premium method.

Reverting to the question of mortality of persons whose lives are heavily insured, it may be of interest to refer to a paper submitted to the Eleventh International Congress by J. M. Laird and L. M. Cathles, who demonstrated that in America large assurances were definitely subject to much higher mortality than other assurances. It was found that the lightest mortality was experienced under policies effected for less than \$25,000, and the rate of mortality increased with the size of policy. The mortality of lives each assured for a total sum exceeding \$500,000 was so high as to cause proposals on such lives to be considered 'border-line' on account of size alone. Individuals carrying life assurance for \$1,000,000 and over experienced mortality of 169% of the normal. Some of the additional mortality was caused by violent deaths of all kinds, including suicide, and degenerative heart disease was largely responsible for the excess mortality where death was due to natural

causes. For this reason, in the United States of America electrocardiogram tests and X-ray examinations of the heart are now required for large assurances, and the amount of cover granted on any one life is graded according to the earning capacity and general financial status.

(b) *Original premium basis and risk premium basis*

In comparing the original premium basis with the risk premium basis, there is the fundamental difference that when business is reassured on the original premium basis the reinsurer secures a share of the interest, surrender and miscellaneous profits as well as the mortality profit, whereas on the risk premium basis the reinsurer only secures the mortality profit on the portion reassured. The risk premium charged by the reinsurer includes a portion of the expense and mortality fluctuation margins contained in the original premium; to what extent the ceding company retains more loading than is sufficient to pay the agent's commission depends upon the terms granted for risk premium reassurance. In the period before the war, when investment conditions were easier and income tax was lower, there was a distinct advantage in retaining the interest profit and the risk premium method was more advantageous to the ceding office, but under present conditions it is not so easy to make a general comparison, particularly in the case of business by obligatory treaty, for there can be little financial difference at the present time between the two bases, provided that the reinsurer is making its fair contribution under the original premium method to the cost of procurement of the business. Further, the practice of allowing a reduction of premium for large policies on the plea that there is a saving in expenses reduces the margin of profit on reassurances on the original premium method.

One aspect of the risk premium method is that an office pays the reinsurer only the minimum portion of the premiums received. This feature is important in the case of an office which is desirous of building up premium income and a substantial fund in the shortest possible time. If such an office decides to finance the gross new business and is able to make profitable investments, then the risk premium method would make the stronger appeal. It has previously been mentioned that the risk premium method is elastic, in that the amounts at risk may be reduced more rapidly than the reserves accumulate on the initial sum reassured, and this point makes it particularly advantageous to the office desiring to retain the maximum portion of its business.

In making comparisons between the two bases of reassurance, it must be assumed that the business is profitable both to the principal office and to the reinsurer, and the most advantageous method of reassurance is that system which will enable the principal office to retain the maximum profit while granting the reinsurer a reasonable rate of premium, including a small allowance for its expenses and profit. Before the war the risk premium method seemed to achieve these conditions, and at the present time it compares favourably with the terms on which facultative business is placed, but it may not always prove to be the cheapest method.

REASSURANCE OF WITH-PROFIT BUSINESS

A special problem arises in regard to the reassurance of with-profit policies, in so far as the reinsurer has no control over the rate of bonus declared by the principal office. Consequently, the reinsurer is in the position of re-

ceiving fixed premiums for an unknown risk, which is an unsatisfactory state of affairs. Under present conditions, bearing in mind the low rate of interest and the high rate of tax, non-profit business is not so likely to be very profitable and may even result in loss, and in consequence the non-profit assurances are unlikely to contribute to surplus and thus increase the rate of bonus declared on the with-profit policies, as was frequently the case prior to the war. It seems, therefore, that as the future prospect for bonuses is less favourable than formerly, the acceptance of reinsurance on with-profit policies at the present time is not so unreasonable but, even so, as the future liability for bonuses cannot be controlled by the reinsurer, this method is theoretically unsound. Nevertheless, in spite of these objections, with-profit policies are frequently accepted by way of reinsurance on the original premium basis.

If such reinsurance were placed on a non-profit basis, as was suggested three-quarters of a century ago, the principal office would lose its share of the surplus arising from mortality, interest and miscellaneous profits, and would receive only the bonus loading as a compensation for the liability for bonus. Bonuses might be declared at a rate higher than that supported by the bonus loading, in which case the principal office would make a loss on the reinsurance.

An alternative is to reinsurance on the risk premium basis, for in that case the principal office receives the bonus loading and all profits except the mortality profit on the portion reassured. Whether this solution is satisfactory or not depends upon the extent to which the bonus is paid out of mortality profit. If there were a sufficient volume of such business reassured on the risk premium basis, it might be possible to arrange a risk premium treaty up to a specified limit as regards sums assured, under which the ceding company receives a share of the mortality profit yielded by the business reassured thereunder. Up to the present time it has been usual for risk premium reinsurance to be conducted on a non-profit basis, but there have been occasions when with-profit treaties have been arranged. The risk premium rates for a with-profit treaty are normally somewhat higher than for a treaty without any share of the profits and, of course, the profits under such a treaty would have no direct relation to the rate of bonus declared on the with-profit assurances, being dependent entirely upon the profit made on the reinsurance.

SPECIAL CASES GIVING RISE TO ADJUSTED BASES OF REASSURANCE

The methods of reinsurance so far described have not included arrangements to meet special circumstances. It sometimes happens that a company is able to retain the whole assurance with the exception of one particular risk; for example, suppose a company has already issued one policy on a life A and receives a proposal on the joint lives A and B. The only risk to be covered is the surplus mortality risk on the life A, which can be arranged on the risk premium basis. Again, it may be that a child's deferred assurance is issued with cessation of premiums on the death of the father. If the company already holds its maximum retention on the father's life, it is necessary only to reinsurance the mortality risk in the event of the father's death before the option date, as the company would be in a position to retain the mortality risk on the

life of the child thereafter. In the case of family income policies, the commuted value of the liability in the first year may exceed the retention limit of the office, but after a few years may be within that figure. Reassurance is therefore only required on the risk premium basis for a few years; alternatively, a portion of the family income benefit may be reassured on the original terms. In the latter case it may be necessary to ascertain whether for the family income benefit alone a negative surrender value arises on the assumption that the assured is select at the time of surrender, and should the principal office reduce its surrender value in respect of the main contract on this account, the due proportion of the reduction should be paid to the reinsurer on surrender of the original policy. The reassurance of a with-profit policy on a non-profit basis is another example of the adjusted method. Sometimes policies are issued with annuity options on maturity and it may not be necessary for the reinsurer to follow these options.

Thus it will be seen that it is frequently possible to adapt the reassurance contract to comply with the requirements of the principal office if it desires to retain as much of the original risk as possible. In other cases it may be necessary to adjust the terms of the contract to conform with the conditions imposed by the reinsurer.

REASSURANCE OF BUSINESS OVERSEAS

Life reassurance is, in some respects, more highly developed abroad than in this country. The strong financial position of British companies results in retentions high in proportion to the average amount of life assurance effected per head, and consequently the need for reassurance is not so great as abroad.

(a) Treaty with deposit of reserves

In the case of the smaller foreign companies, reassurance often takes the form of a financing operation in addition to the provision of cover for the larger mortality risks, and treaties are therefore more frequently on the original premium basis, or on an adjusted basis. In some cases a quota share of the business is reassured, but usually the ceding office reassures the surplus over an agreed figure. The retention may vary according to the class of policy or quality of the risk.

The majority of foreign treaties, when concluded on the original premium basis, make provision for the deposit of the actuarial reserves, either in cash with a guaranteed rate of interest, or by securities. This is due in most cases to legislation which may provide that the national company must constitute reserves for its gross business. If the amount of the reserves to be deposited is calculated on a net premium basis (without any allowance for initial expenses) it will be seen that the initial financial benefit obtained by the ceding office is the difference between the initial commission and one year's loading, the latter being the difference between the office premium and the net premium. The initial commission is gradually liquidated by the loadings received.

The cash deposit of reserves is a convenient method for the reinsurer as the problem of selecting foreign investments does not then arise, although it can be assumed that the ceding company will only guarantee a rate of interest below that which may be earned. Nevertheless, in negotiating for the treaty,

it is easier to assess the desirability of the business when the rate of interest which will be guaranteed is known. In the event of a fall in interest rates, difficulty may arise, but the responsibility will rest on the ceding office. In that event, the premium scale should be revised and the reassurer should receive a lower rate of interest on the business ceded at the higher premium scale.

(b) *Risk premium basis*

When an offer of reassurance is made in respect of foreign business on the original premium basis, in addition to the normal considerations of rates of premium and commission, investments, etc., the incidence of taxation must be studied. The premiums offered will be loaded to cover local taxation, but if a foreign life fund is not constituted in respect of such business there is also a liability for British taxation. If the reassurer is not liable to foreign taxes, the commission required by the ceding company will probably include an allowance for such taxation, which sometimes takes the form of a percentage of the premiums. In effect, therefore, the reassurer will be subject to dual taxation. The liability for British taxation, on the basis of interest less expenses, means that the reassurer needs a higher gross yield on its investments than that required by the ceding company and it may be found that the reassurer is therefore unable to grant reassurance on the terms offered.

In such circumstances, the risk premium basis is particularly suitable from the point of view of the reassurer, and it may be equally agreeable to the ceding company provided that it is not seeking financial assistance in respect of the cost of writing its new business. There may be some initial difficulty in deciding upon a scale of risk premium rates, as the reassurer may require a substantial margin until some experience of the business has been obtained, after which period some adjustment may be made, either by payment of enhanced commission, reduction in the premium scale, or payment of a proportion of the profits earned, according to the circumstances.

The sums reassured and the reassurance premiums would normally be payable in the same currency as that of the original policy.

(c) *Modified risk premium method*

Some reassurance treaties are drawn up on the same lines as for the original premium basis with deposit of reserves, but with a proviso that the actuarial reserves deposited are the property of the ceding office. This type of treaty might be described as a 'modified risk premium treaty', or perhaps a better name is the 'natural risk premium treaty'. It is a means whereby the reassurer receives a risk premium, but at the same time plays its part in the financing of the business. It may be of interest to consider the implications of this method in some detail.

Under this method the risk premium is derived from the office premium of the ceding office and is calculated by deducting the increase in reserve from the office premium. The relation between the net premium and the risk premium may be seen from the following equation:

Since ${}_nV_x + \pi_x = v_{n+1}V_x + vq_{x+n}(1 - {}_{n+1}V_x)$,
 the net risk premium $= vq_{x+n}(1 - {}_{n+1}V_x)$
 $= {}_nV_x + \pi_x - v_{n+1}V_x$
 $= \pi_x - (v_{n+1}V_x - {}_nV_x)$.

Hence the net risk premium is obtained from the net premium for the original assurance by deducting from it

$$v_{n+1}V_x - {}_nV_x.$$

Now the difference between the office premium and the net premium represents the loading received by the ceding office, and under this method the whole of the loading is passed to the reinsurer. Hence the gross risk premium is obtained by deducting the above difference of reserves from the office premium. Thus the risk premium is

$$P_x - (v_{n+1}V_x - {}_nV_x).$$

When the individual cessions are made on the risk premium basis the calculation of the amounts at risk and reinsurance premiums must be made for each year of assurance, but there is an advantage in the modified method in that it is only necessary to keep records of the reinsurer's share of the office premium and to calculate the reserves at the end of each calendar year for the portfolio reassured. The calculation of the part of the total office premium to be retained by the ceding office in respect of the increase in reserves (sometimes called the 'reserve premium') may be made in bulk, the formula being

$$v_{n+1}V' - {}_nV',$$

if the calculation is made at the beginning of the calendar year, where V' represents the reserves for the portfolio. The reinsurer is, in effect, credited with the reserve at the commencement of the year, and therefore may be debited with the full amount of the claims incurred. However, since under the risk premium method the risk premium relates to the difference between the sum assured and the reserve, the 'reserve premium' and the total claims should be adjusted for the reserves on claims incurred. In practice the calculation of the amount due to the reinsurer is made at the end of the calendar year, so that there are certain adjustments by way of interest on the various items to bring the values up to 31 December of the year in question.

Under this method the reinsurer receives the full loading and the full commissions are paid as for a treaty on the original premium basis. The initial commission is therefore much greater than the risk premium if the reserves are calculated on a net premium basis without any adjustment for initial expenses. This initial loss is recovered gradually from the future loadings received, or, if the policy is discontinued, it should be recovered from the surrender or lapse profit. If the policy lapses after being in force only a short period a loss may be made.

The rate of interest used for calculating the risk premium is normally slightly in excess (to the extent of, say, $\frac{1}{4}\%$) of that used for the reserves, and the reserves should be calculated on the same interest basis as the office premium. Hence the reinsurer may receive a small share of interest profit.

It will be seen that this method is to the advantage of the ceding office, since it only pays a small proportion of its premium income for the reinsurance protection secured, and at the same time, has control of the gross funds, so that if its investment policy is successful it may make interest profit on the gross reserves, while the reinsurer is financing the cost of underwriting the business which is reassured; thus the ceding office has the benefit of a treaty on the original premium basis.

CONCLUDING REMARKS

The development of the risk premium basis in this country has been gradual, but the method should become more popular in the future. The treaty method is unlikely to make rapid progress since the larger companies will prefer to retain their liberty to reassure with any company, with a view to obtaining reciprocity, but there may be occasions when automatic cover will be granted for special policies (e.g. family income assurances), where the initial risk is relatively great. The treaty method will, no doubt, attract the smaller companies if there is a large proportion of business to be reassured.

It seems unlikely that any fundamental change will take place in this country of the methods adopted for life reassurance. The application of any system on the lines of the 'excess of loss ratio' method is unlikely to appeal to either the principal companies or their reassurers, for although it would be satisfactory to the principal office to limit its liability to a certain percentage of the expected death strain, the reinsurer would have to retain the option of adjusting the rate of premium, so there would be no long-term security in that method.

In the post-war period reassurance overseas may provide further scope for the treaty method, and from a national point of view the possibilities in this direction should not be ignored. This country will be in need of invisible exports to replace interest income on foreign investments that have been utilized for the war effort. Foreign reassurance is one of the means whereby we can secure invisible export, for although a treaty with deposit of reserves involves an initial financing cost, resulting in the purchase of foreign currency, if the treaty runs well it produces an income in the currency which will ultimately outweigh the initial cost. The risk premium method is preferable from the national point of view as the initial financing operation is avoided and profits become available much more quickly.

The effect of the war on the Continent of Europe must be to impoverish the nations, and one of the resultant problems may be to build up the European assurance companies. We may be able to play our part in the rehabilitation of Europe by granting reassurance facilities, and in so doing we may be of immediate service to those nations while building up ultimately an important national source of revenue.

There is a tendency in some countries to introduce legislation which discourages British offices from continuing to transact direct assurance business, but it may still be possible to transact reassurance business in those countries.

While the need to conserve national resources is appreciated, it is to be hoped that the tendency to nationalize reassurance business will not develop throughout the world. Reassurance is an international business and, if transacted on a world-wide basis, greater security results from the wider spread of risk.

In conclusion, I wish to express my appreciation of the helpful discussions I have had with several members of the Institute and of their constructive criticisms.

ABSTRACT OF THE DISCUSSION

Mr A. J. Gale, in opening the discussion, said that, broadly speaking and apart from general office policy, the maximum limit of retention was likely to reflect the dimensions of the fund. If an office had a modest limit, exchanging a fair number of reassurances with a degree of reciprocity, there seemed to be good reason for using a rigid limit throughout a wide range of the ages at which the business was transacted, and there were practical advantages in a fixed figure which would be known amongst both indoor and outdoor staff. If, on the contrary, an office had a high limit of retention, other factors came into prominence, and he felt that it was the rather higher limit used for the normal range of ages which had resulted in the practice of many offices—particularly in North America—of varying their limits according to age and mortality standards.

He had experimented with a table of reserves, and had found that it was reasonably simple to obtain an index figure for short-term endowment assurances, but he had found some difficulty in arriving at a rough index for whole-life business. He thought, therefore, that the practical difficulties of fixing a single, simple index would drive offices to more empirical methods. Many offices, he believed, took the age at entry into account in fixing their limit, and offices using somewhat lower fixed limits probably gave indirect effect to the same idea because the limit applied mainly to the higher ages at entry where reassurance was usually required. He thought that a lower limit should be used for the older ages because the medical selection was more difficult; some doctors held the opinion that the selection of risk at ages over 60 should be considered to be medically speculative.

The author had not touched on the limits of retention for disability or accident insurance. He believed that, as a result of their experience, American offices had fairly low limits for those classes of business. He also believed that British offices were inclined to reduce the limits retained on new contracts which covered war risks. The author had not referred to currency; he would suggest that an office with business in currencies not freely exchangeable should consider the size of its fund in the particular currency in fixing the maximum limit of retention for that currency area.

The author had said that a higher limit of retention could be used for a separate non-profit fund. That statement needed amplification. He felt that the fundamental reason for reassurance was the protection of the fund against insolvency, and though the problem of securing the emergence of surplus at a regular rate had become more prominent, the fundamental reason should never be overlooked. For example, when war broke out bonuses were immediately curtailed but existing non-profit business had to remain on the books without adjustment. The same remedy of passing a bonus was always available to any with-profit fund that was faced with an adverse mortality experience, and on those grounds it seemed that there was a case for a higher limit for with-profit business.

He wondered how much emphasis should really be attached to the author's criticisms of delay, extra work and expense under the facultative method. The incidental expenses were nominal in relation to the size of the assurance and the extra work would probably have its own reward in the experience gained in the consideration of large risks, both from a medical and an actuarial viewpoint. Further, he doubted whether many large cases fell through in consequence of actual administrative delay in settling reassurances.

The relevant factor in comparing the facultative and obligatory methods was the number of reassurances involved. Where limits were small and reassurances reasonably numerous, the treaty method would have a real advantage in curtailing work, and the suggestion that the very few large cases should be reserved for individual consideration appealed to him.

The author had made two suppositions about the mortality experience of lives assured for large amounts, and it was a great pity that so little statistical evidence on the point was available in Great Britain. Statistical evidence of heavy mortality under large policies might conceivably alter the attitude to reassurance. Reference had been made to the American experience of large risks, and it was a commonplace that the 1929 depression cost the American companies quite a large amount, though disability insurance of large risks was responsible for a part of the loss. The attitude of the North American companies to reassurance remained very cautious, and it was undoubtedly true

that the unfavourable experience had made North American offices require electro-cardiogram tests as a routine matter, not only for policies requiring reassurance but also for smaller policies at ages as low as 45. He had discussed the point with a doctor who had a large middle-class practice; the doctor was very surprised to hear that electro-cardiogram tests were not obtained as a matter of routine for even small assurances at the higher ages. He felt that an electro-cardiogram test was required for even the smallest proposal on a life over the age of 55.

Very copious and informative credit reports were used in America as corroborative evidence in considering the moral hazard and the general financial picture. Those reports played a big part in the consideration of a proposal for a large assurance. He did not think for a moment that such comprehensive reports could be obtained in Britain, but, from an underwriting point of view, they were certainly very helpful.

Opportunities of reassurance between offices were warmly welcomed, and offices endeavoured to see that there was, broadly speaking, a balance between their cedings to and reassurances from other offices with which they had friendly reassurance associations. The business was conducted either by facultative reassurance or by bilateral treaties on the original premium method. In the result, the life assurance funds were approximately of the same size as they would have been if no reassurance had taken place, and a more even spread of risk had, therefore, been obtained without undue trouble and complication. If the risk premium method were used, there would be no fundamental variation in the way the mortality risk was spread. With regard to interest earnings, the size of the funds would remain basically unaltered, and such opportunities of interest profit as might exist would be just as much present under the original premium method as under the risk premium method.

The fundamental advantage claimed for the risk premium method did not necessarily exist for a typical ordinary life office operating in the United Kingdom. In addition, if there were a degree of reciprocity, surrender profits and initial procuration costs would tend to be spread evenly.

In the circumstances outlined, there seemed little incentive to change a traditional practice which had presumably proved not unprofitable to those concerned. He did not suggest that there was no place for the risk premium method. A reassuring office which obtained a good spread of such term risks might well find the method suitable, though the method would seem to be open to the criticism that the resulting small fund would need a considerable contingency reserve behind it.

In his paragraph on the reassurance of with-profit business, the author might well have pressed the point of the closed fund which, in practice, had on occasions made the reassuring office's bargain a most expensive one. The difficulty might be avoided by a provision in the reassurance agreement that, if the ceding office should cease to do new business, the terms on which the bonus was reassured would be reconsidered. The author made no mention of the necessity to value specially reassurances which carry bonuses different from the bonuses declared by the accepting office, a point which had some weight when expense was considered. Theoretically, he agreed with the author that there was no case for reassurance of with-profit business by the original premium method with the ceding company's rates of bonus, and he preferred a direct policy effected with the accepting company.

Reassurances of foreign risks had not been sought by British offices. He agreed that the general mortality of the white population in northern Europe and North America might not be very different from that of Great Britain: but little information was usually available about the principal office's underwriting standards and the standing of the medical examiner, and perhaps very meagre agents' reports on the financial standing of the proposer. Even proof of age in some parts of Europe presented a problem, and there was also the problem of currency. He agreed that the risks of reassuring contracts expressed in another currency could be reduced to a minimum by the risk premium method, but the risk would not be entirely eliminated. As far as most of Europe was concerned, he felt that some time would elapse before foreign reassurances could be underwritten with any confidence. North and South America offered much better prospects, but only with the consent of the various foreign-exchange controls.

Throughout the paper, the author had had to make assumptions about the mortality experience because British statistics relating to large assurances were not available. He had referred to the American mortality experience of large assurances. Many did

not believe, and the speaker shared the opinion, that the mortality experience in Britain would necessarily be similar to the American experience, but, without appropriate statistics to show the contrary to be true, he thought that the American statistics should be borne in mind when large assurances were being considered.

Mr F. M. Redington said that he believed the simple expressions for the standard deviations of amount of claims and amount of strain were not as familiar to members as the corresponding expression for number of claims.

The expressions were:

- standard deviation in total number of deaths, $\sqrt{[\Sigma(pq)]}$;
- standard deviation in total amount of death claims, $\sqrt{[\Sigma(S^2pq)]}$;
- standard deviation in total amount of death strain, $\sqrt{[\Sigma(s^2pq)]}$;

where Σ referred to summation for each *life*, S was the total sum assured on the life, and s was the total sum at risk on the life.

Those expressions, simple though they were, were not easy to calculate because the data were not usually available in a suitable form. It was easy, however, to obtain a rough approximation for ordinary purposes. For example, a minimum value could be obtained by ignoring duplicates and assuming that the average sum assured, or death strain, applied to each life. Thus a minimum value for the standard deviation of death strain was $\bar{s}\sqrt{(\Sigma pq)}$, or roughly $\bar{s}\sqrt{\theta}$, where \bar{s} was the mean sum at risk per policy and θ was the number of claims by death. That expression could be evaluated immediately. The addition to be made to the minimum value to arrive at the correct value depended on the spread of the sum at risk round the mean and on the number of duplicates, and it varied for different offices. Generally, however, the correct value would be between one-and-a-half and three times the minimum.

He thought that most actuaries would be surprised at the low values which resulted from applying the formulae: the disturbance in surplus which arose from mere statistical randomness of deaths was small. Moreover, the results applied to the experience of one year only. If a period of n years were taken as a whole, the standard deviations had to be multiplied only by the square root of n , whereas the surplus with which the deviation had to be compared increased in direct proportion to n itself. The relative importance of the statistical fluctuation was thus further reduced.

Turning to the question of maximum retention, the expressions he had given were valid whatever the sizes of the sums assured on the individual lives might be, but, if there were one or two policies for very large sums assured, the interpretation of the standard deviation needed consideration. Taking an extreme case, if the figure for the standard deviation in the total amount of claims were £50,000, but included in the calculations there were a single policy for a sum assured of £200,000, the probability of a fluctuation in claims of £200,000 was of the order of the value of q_x on the life which was assured for the large sum and was not the extremely low probability which was normally assigned to a deviation of four times the standard deviation. That feature was not, however, of great importance, because such an extreme example as the one he had had to choose in order to give a clear illustration would not arise in practice. It could generally be taken that the expressions he had given would serve as practical measures provided the maximum sum at risk on any one life was less than the total calculated standard deviation. The conclusion to which he came, therefore, was that the statistical fluctuation—which was the reason for imposing maximum retentions—was much smaller than was generally supposed, particularly in relation to the fluctuations due to other causes. The purely theoretical fluctuations were considerably smaller than the actual fluctuations in claims because of changes in basic mortality as a result of war, changes in weather conditions, medical improvement and so on; and they were even smaller than the deviations which arose from causes not connected with mortality, such as interest rates, expenses and taxation. He believed that offices could retain considerably larger sums assured than they did, particularly if they adopted some system of reasuring one year's strain with another. Offices which valued quinquennially did so to some extent automatically; others could do so by setting up a claims contingency reserve to stabilize the yearly death strain.

He thought, however, that theoretical conclusions should not be pushed too far. There would probably be suspicion of policies for large sums assured, not only from the

purely statistical viewpoint but also from doubt as to the mortality amongst lives assured for large amounts. The logical answer to that, however, was that the situation would not be saved by decreasing the amount retained. If, indeed, the mortality of lives assured for large amounts were suspected to be heavier than the normal, the premiums should be increased.

Mr L. W. Collingwood said that in Table 2 the author had not indicated the mortality basis assumed for the premium of the ceding office, but, from the manner in which the theoretical table ended, he imagined that he had assumed that the mortality basis for the premiums in the ceding office was the same as the mortality used for the premiums and also for reserves in the reinsuring office. In practice, it was probable that the three bases would all be different.

He had available some figures prepared about seven years earlier which related to two whole-life non-profit policies. In the first example, the office premiums were based, he thought, on the $O^{(M)}$ $3\frac{3}{4}\%$ table, the valuation reserves were based on the A 1924-29 3% table, and the risk premiums were on some basis unknown. The risk premiums were applied to the death strain at risk computed on a $3\frac{1}{2}\%$ valuation reserve. The balances of the office premiums, after payment of reinsurance premiums, were accumulated at $3\frac{1}{2}\%$, and he found that after nine years the accumulation of the balances came to £26 per £100 sum assured, for a life aged 60 at entry, whereas the reserve which it was necessary to hold on the ceding office's valuation basis at 3% was £32. In the second example, the ceding office used the A 1924-29 select table at $3\frac{1}{4}\%$ for office premiums and the A 1924-29 ultimate table at 3% for valuation, and, again, the basis for the risk premiums was unknown. In that case the age at entry was 56 next birthday, and the assumption was made that the life lived 30 years. After nineteen years the ceding office commenced to pay to the reinsuring office a larger premium than it received. At that point, the accumulation of balances at 3% was £37, and the reserve £51. At the end of 30 years the accumulation of balances was only £43, and the reserve £71, again involving a valuation strain. Those examples might show, not that the risk premium method for whole-life non-profit assurances was rather expensive, but that in each case the office premium was inadequate in comparison with the reinsurance premium.

The risk premium method of reinsurance was of great value to small offices where the limit of retention was £500 or even £750. Such offices were not in a position to make reciprocal arrangements with larger offices. It was also useful to a closed fund which was very vulnerable to fortuitous adverse mortality experience because there were only a few policies left in the fund. He knew of one instance in which the risk premium method was adopted a few years ago because there were only seventeen policies left, including two whole-life policies, and with the maturity dates of the endowment assurances spread over the ensuing twenty-six years. In that case the risk premium method was of great value as the means of avoiding violent fluctuations in the valuation surplus.

Mr T. R. Suttie desired to confirm what earlier speakers had said regarding a point which he considered rather obvious. If the basic mortality under policies for large sums assured were worse than the average, then most British offices gained no protection against adverse mortality by reinsurance. Each office generally hoped to receive by reinsurance as much as it gave away and there would, therefore, be no reduction in total amount at risk under such policies.

He wished to expand the author's suggestion on p. 341 of the paper that an office making a quinquennial valuation could have a larger retention than one making an annual valuation. He would suggest that an office making a bonus reserve valuation could adopt a still larger limit of retention, since it could legitimately spread fluctuations in the mortality experience over the whole lifetime of the existing policies and not merely over the valuation period.

Mr George Green said that there was one point which had not yet, as far as he knew, been dealt with in the *Journal*, one which might sound at first rather a contradiction in terms, namely, the reinsurance of declined lives.

In Holland certain offices of good standing agreed some years ago to form a subsidiary office which would consider lives which they had declined. If one of the constituent

companies did not wish to accept a life, the proposal was sent to the subsidiary. If the proposal was then accepted on special terms, the policy was issued by the original company to which the proposal had been made but the whole risk was reassured with the subsidiary. In the result, after twenty years' existence, that office's experience came out just about level. The usual method of dealing with the declined lives was to offer a combination of a heavy debt on the policy, running off in four or five years, together with a rating-up of the age. If some information concerning the nature of the experience of that office could be gathered and brought before the members of the Institute, he ventured to think it would be very useful and interesting.

One of the most curious cases of reassurance that had been arranged was one in which a Continental company acted as agent for a closed fund to supervise the running off of the business in a certain country. The Continental company was anxious to take over the portfolio by way of transfer, but, as the fund was closed, that was not possible. It arranged, however, to take over all the policies by reassuring all the profit or loss that might arise from mortality alone. An account was kept under which each year opened with the valuation reserves in hand; the net premiums under the valuation table were charged to the account, the valuation rate of interest was allowed, claims and the reserves on surrenders, etc., were paid, and the difference at the end of the year between the fund thus ascertained and the total valuation reserves constituted the profit or loss on mortality. If there was a profit, the Continental company kept it; if there was a loss, it made it good.

Mons. F. Camps (a French visitor) mentioned some features of life assurance in French Africa in 1942-44. When Africa was cut off from France, there were in Africa numerous branch offices which became temporary head offices, with many of the inconveniences attending new offices starting business. They wanted reassurance for their new business, and they obtained it by several different methods.

The first method was by treaty with deposit of reserves. The amount reassured was a quota share between two agreed figures (the lower one being practically nil) together with the surplus over the higher figure. In some cases the ceding offices reassured only the surplus over an agreed figure. There was a provision for the deposit of the actuarial reserves in securities, those reserves being calculated on the basis of the 'prime d'inventaire' according to French law.

The second was a facultative method without deposit of actuarial reserves. The reassurance was granted for a figure proposed by the ceding office and agreed by the reinsurer. It was a short-term assurance, renewable each year. The reinsurer assumed only the mortality risk.

Another method was a modified risk premium treaty, which was practised in the way explained in the paper; the reinsurer only assumed the mortality risk for a yearly decreasing amount, and had no reserve to provide. Finally, there was the interest risk premium treaty. That was an example of the innumerable aspects of the wide field of reassurance. A few companies, more confident in the health of their insured lives than in the expected rate of interest, wanted the limitation of the latter risk.

He thought that a further increase of reassurance in North Africa by the facultative method without deposit of actuarial reserves and by the modified risk premium treaty method was expected, and it was believed that those methods, together with the method of treaty with deposit of reserves, would be improved to meet the new aspects of the business after the reintegration of North Africa into the French Empire.

Mr E. W. Phillips was prompted by Mr Green's interesting reference to co-insurance in Holland to refer to the possibility of setting up a syndicate or subsidiary company to offer life assurance protection to those who were considered to be uninsurable. He was not so much interested in the larger policies, where there might be a moral hazard, but he felt a keen sympathy for the ordinary man with dependents who had a genuine need for assurance protection. Was the mortality of the unacceptable lives as heavy as was sometimes supposed? He did not know of any reliable figures, nor were any likely to become available unless a number of companies joined together and experimented by offering protection of limited amount, say £1000 on any one life in the first instance.

Mr W. H. Clough said that it had been suggested by Mr Redington that reassurance was unnecessary. But the fact remained that reassurance continued. He thought there was a great deal in what Mr Phillips had said on the question of a pool similar to those that had been established in other countries, not only for declined risks but for sub-standard risks as well.

The experience in America indicated quite clearly that evidence in addition to the usual medical evidence might be advisable.

If an investigation were to be made in Britain with regard to large risks, more thought would have to be given to what constituted a large risk. It was not just a question whether a man applied for a large amount of assurance at any one time, but also whether he built up a large amount of assurance over a period of time. The risk in the latter case might be better than the risk in the case of a man who applied for a single policy for, say, £250,000, but no evidence had yet been forthcoming from British business experience that large assurances produced a substantially higher mortality.

One speaker had referred to the high cost of risk premium reassurance, but he was always doubtful of those theoretical calculations. The question whether the reassurance did or did not pay the ceding office was not settled by running off a fund at hypothetical rates of interest and mortality; the actual experience with regard to interest and mortality had to be taken into account. He thought it was also true that a large surplus might be made from surrenders, at least in Great Britain, and that that surplus and other miscellaneous profits were retained by the ceding office.

It had been suggested that the United States might be a safer ground for reassurance business than the Continent of Europe. From the little experience he had had of the mortality of Europe, there was no reason to suppose that reassurers would suffer even during the war years. Mortality on the Continent, as in Britain, had been better than could have been expected. He did not hold the view that Europe was unsafe either for direct or for reassurance business, and there was a national obligation to secure what was an invisible export. It was one of the easiest ways of bringing foreign currency to Britain, without any shipment of goods, and therefore it was a useful factor in the national economy.

Mr H. E. Melville said that Scandinavian actuaries had done a good deal of mathematical research into the theory of risks and the means of dealing with the problems of large assurances. He himself felt that those theoretical investigations were not of much practical help, and he agreed with previous speakers that the chief problem was to consider the effect of a few large claims on the surplus and on profits and bonuses.

The questions had been raised in the discussion whether the facultative method of transacting reassurance business was likely to cause delay, and whether the advantage from that point of view was not with the automatic method. He thought that the really important thing in handling facultative reassurance was to put the facts to other offices quite clearly and fully, and not to leave loose ends to be tied up later. A few years ago he had placed on the London market £600,000 on one life within about one week.

The author had given an interesting history of reassurance practice and its development, and had referred to the Reassurance Agreement of 1900. No participant in the discussion had criticized that Agreement, but he knew that there were one or two offices, not parties to it, which believed it to be unsatisfactory. He had found it to work well, but he thought it would be useful if any criticisms could be ventilated and discussed.

Mr W. R. Moore, in closing the discussion, said that he thought the author had been extremely fair, though no doubt he had a leaning towards the risk premium method.

The author had said that, under the facultative method, no commission was paid by the accepting office in respect of overhead expenses. He (the speaker) agreed with the opener that there was not much involved in that point.

As between the facultative and obligatory methods there had not been much discussion. The author thought that the obligatory method was more useful to a young company, and there was no doubt that a young company might have difficulty in securing facultative reassurances, so that the obligatory method might be useful. But if a young company could secure reciprocal offers it should do so, even if the commission question were a little worse than under the obligatory method. The office would obtain

a better spread of business (a young company starting business would probably have only a limited source of new business) and would be able to check its underwriting against the underwriting of other companies. One of the good features of the facultative method was that it was possible to keep in line with the underwriting of other offices.

The main argument put forward in support of the risk premium method was that only the mortality profit was given away. He agreed with the author that the risk premium method could be very elastic, and it was undoubtedly of great use for the special cases, all of a decreasing assurance nature, which the author mentioned, as well as for foreign business in which the difficult currency question was overcome. He had been pleased to hear that Mr Clough thought that the mortality in occupied Europe would be satisfactory: nevertheless, he felt there was need for care, considering what some of the people of Europe had suffered during the occupation.

The author had made a good point in connexion with the reassurance of with-profit business. Most actuaries from time to time were faced with an offer of reassurance of with-profit business, and had to decide what sort of bonus the ceding company was likely to pay in future, and whether the premium offered could earn as much profit in their own office as in the other. Those who administered closed funds which were giving very large bonuses might feel sympathy for the reinsuring company which had to follow, perhaps, a 10 % rate of bonus; but apparently offices were content to take the extra risk because, if they were not, some alteration would already have been made.

The logical method of developing the risk premium method to suit participating business would be the pool mentioned by Mr Phillips and other speakers; it need not necessarily be confined to declined risks or even standard lives. He believed that in Norway a pool had been formed for all classes, and by that means the surplus risk was spread in the pool, and each office recovered an amount of mortality profit from the whole of the business equivalent to its contribution to the pool. He had often wondered why the leading British offices had not come to an arrangement to reassure their business in their own pool, so retaining all their sources of profit, and it might be particularly useful to deal with participating cases on those lines.

On the subject of retentions, he agreed with the opener. The author seemed to think that it was justifiable to have larger retentions where there was a separate non-profit fund, as it did not matter so much whether the profit emerged evenly. But with non-profit business any deviation of mortality profit or loss was a much bigger percentage of the total profit since there was no bonus loading profit. Therefore the speaker thought that if there was to be any difference there should be smaller limits of retention for non-profit business.

He agreed with the author's suggestion that the limit of retention should be reduced as q_x increased. The author thought that most offices did not vary the limit for rated-up lives, but that was not his experience in practice. It was difficult to be certain about the rating of an under-average life, and it was just as well to spread the risk.

In conclusion, he would echo what Mr Melville had said, namely, that the Reassurance Agreement had been in force for 45 years, and that it seemed to work satisfactorily. It had stood the test of two major wars, and had undergone very little alteration.

The President (Mr R. C. Simmonds) wished to enter a plea—on general grounds and not in criticism of the paper—for the use of a word less ambiguous than 'reassurer'. He, and others doubtless, had found it difficult to tell in the course of ordinary work whether it was the principal office or the guaranteeing office that was really meant.

Nothing had been said about what might be called the general attitude to reassurance. It seemed to him that the principal office could either ask what it would make out of a reassurance or could adopt the view that reassurance was the means whereby offices helped one another. In other branches of insurance the former standpoint had often been taken. He did not say that was wrong in itself, but he was quite sure that it was dangerous—especially for the guarantor—and it did introduce into what was a relatively minor branch of life assurance administration the need to have regard to the maxim that the buyer should beware. He agreed with the second view, namely, that reassurance was the means whereby offices could help one another with their large assurances and therefore the principal office should be willing that the guaranteeing office should share and share alike with it.

He had been glad to hear Mr Redington raise the question of the theory of limitation of risk. Though it would be felt that the practical points that he, Mr Melville and others had mentioned were sound, it was desirable that they should not only bear in mind, but also study, the very considerable amount of theoretical work that had been done, particularly abroad, on the subject.

As was to be expected, there had been a certain amount of controversy over the merits of the 'full reassurance' and the risk premium methods. He thought that emphasis had been laid originally on the point that the risk premium method gave protection to the principal office for the element—mortality—that was regarded as the uncertain feature of the transaction. The principal office did not have to part with money that it expected to be able to invest advantageously. Should they not consider whether circumstances had changed in that respect? Mortality was not the only risk and might not even be the main risk. Accordingly, there might be a better case for full reassurance than there had been in the past. Yet it was difficult not to be impressed by the great flexibility of the risk premium plan in the cases mentioned by the author and others.

It had been an excellent discussion—lively and with short, crisp speeches—and for that, as for the paper itself, they were indebted to the author, to whom he moved a hearty vote of thanks.

Mr G. T. Foster, in reply, said that he had hoped that there would be a full discussion on the merits of the risk premium method, and he was glad that one had taken place. If business were exchanged on the original premium basis, the exchange would be a fair one if the business accepted and reassured were approximately equal both in volume and in quality. But it was questionable whether there was that equilibrium in practice, and, if there were not, was there not a case for the risk premium method? Under that method, only one source of profit was given up, namely, the mortality profit; further, the risk premium method was flexible so that the principal office could retain a constant amount at risk, and would thereby retain the maximum share of the mortality profit.

He agreed that when the limit of retention was being fixed the size of the fund should be considered, but the emphasis should be on the surplus rather than on the fund. He had not included disability benefits in the paper as he had not thought the matter was of general interest, but he agreed with what the opener had said. In considering offers of reassurance from abroad, not only would the question of exchange variations have to be borne in mind but also the characteristics of the country from which the offer originated, and the quality of the business that might be expected. If the business were on the original premium basis, it would be important to equate assets and liabilities so that exchange differences were largely eliminated. If the risk premium basis were used, there might be differences due to exchange, but in practice such differences were not unduly troublesome.

He was grateful to Mr Redington for his remarks on a difficult subject, and for giving the formula for an approximation to the standard deviation of the death strain. He found some difficulty in determining a relationship between the amount of the limit of retention and the standard deviation of the death strain, and it seemed to him that the latter was merely a part of the evidence to be considered when the limit was fixed.

Mr Collingwood had inquired how the premium of the ceding office in Table 2 had been calculated. The rates of several offices had been compared and the premium of £4. 15s. % seemed to be a representative market rate, which could be reproduced approximately by the formula

$$\frac{100\pi_{x:n} + \frac{2}{a_{x:n}} + 15}{.95}$$

based on the A 1924-29 select table at $2\frac{1}{4}$ %, where $x=40$ and $n=20$.

He would not attempt to add anything to the suggestion of the formation of a pool to deal with the acceptance of declined risks, except to mention that the idea underlying the reassurance treaty for substandard risks was somewhat similar.

He welcomed the contribution to the discussion made by Mons. Camps; he had been particularly interested to hear of the way the modified risk premium method had been used in North Africa.