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THE VALUATION OF THE OUTSTANDING LIABILITY FOR PAYMENTS DURING INCAPACITY IN RESPECT OF WORKMEN'S COMPENSATION IN THE COAL MINING INDUSTRY

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INTRODUCTION

According to the Home Office Statistics of Compensation paid during the year 1938, nearly 40% of the number of cases of compensation in the seven main groups of industries in Great Britain occurred in the mining industry, and 80% of the compensation to workers in the industry is paid by employers who insure their Workmen's Compensation risk with Mutual Indemnity Associations. As these Coal Trade Mutual Indemnity Associations deal with about one-third of the compensation paid in the seven main industrial groups, the experience of the larger associations is capable of useful analysis according to the age of the workman, the cause and effect of the accident or industrial disease, and the degree and duration of the resulting incapacity.

In addition to the periodical valuations required to ascertain the financial position of the funds, valuations are also required for the purpose of determination of possible liability to taxation and in connexion with trusts operating under the Workmen's Compensation (Coal Mines) Act, 1934. The valuation of the assets and liabilities of Mutual Associations formed part of the recommendations of the Committee on Compulsory Insurance (1937), it was referred to in evidence given before the recent Royal Commission on Workmen's Compensation, and the question is of special interest in view of the terms of reference to the Inter-Departmental Committee on Social Insurance, which include the consideration of the subject of Workmen's Compensation.

While variations in the methods adopted by valuers must be expected in view of the differences in the systems of insurance in force, discussion amongst members of the Institute may result in a greater uniformity of method, which would be specially desirable if the matter should become the subject of future legislation.

UNEXPIRED RISK AND OUTSTANDING LIABILITY

The reserves which should be held in connexion with non-fatal accident risks are generally divided under the two headings of 'Unexpired Risk' and 'Liability for Outstanding Claims'.

In the case of most of the Mutual Indemnity Associations the premiums paid or calls made, whether paid quarterly or yearly, usually cover periods coinciding with the end of the financial year of the associations. The liability under the head of 'Unexpired Risk' is, therefore, mainly for cases of late notification of claims, and this can be allowed for, as particulars of the majority of such cases are known at the date when the valuation is actually being made. In some Mutual Associations the member bears the cost of the first six months

of incapacity, and this time lag ensures that there is little liability under this head, as a claim to be successful has normally to be made within a period of six months. As mentioned later, any recurrence rate on cases for which the member has already paid his premium can be allowed for by using a net rate of discontinuance (i.e. the rate after deducting recurrences) in the calculation of the first five years' liability and after the first five years by including such risk under the head of latent liability.

The main reserves required for non-fatal accidents come under the second heading of 'Liability for Outstanding Claims', when this is understood to cover not only the present value of the future liability in relation to the weekly payments then being made but also reserves which may be necessary to cover possible increases in the rates of compensation being paid, any latent liability for claims in connexion with accidents which have occurred during past periods of insurance for which no compensation is being paid at the date of valuation, and any reserve which should be made to cover the legal, medical and administrative cost of dealing with the cases in the future.

DIVISION OF COST ACCORDING TO DURATION

In considering the valuation of outstanding liabilities it is convenient to divide the cost under three headings according to duration of incapacity, viz. the first 26 weeks of incapacity, the next $4\frac{1}{2}$ years and after 5 years. These are merely arbitrary divisions. As already mentioned, in some Mutual Associations the cost of the first 26 weeks of compensation is borne by the individual members, and even when this is not so, the first 26 weeks forms a convenient division from the point of view of seriousness of injury. The next point of division, viz. that of 5 years from the date of accident, is chosen for two reasons: (i) it has been found by experience that after a period of 5 years most of the accident cases (as distinguished from those of certain industrial diseases such as miner's nystagmus) are comparatively static, i.e. the total or partial rates of compensation remain practically constant and the rate of recovery is small; (ii) the schedule submitted to the Board of Trade under the Assurance Companies Act, 1909 (the provisions of which may, perhaps in some modified form, be applied to Mutual Indemnity Companies) requires that full details shall be given of all outstanding cases of over 5 years' duration.

DIVISION OF CASES BETWEEN ACCIDENTS AND NYSTAGMUS

In valuing outstanding claims it is advisable to adopt different methods in the case of (*a*) accidents, and (*b*) nystagmus. Experience has shown that the longer an accident case is on the books the less likelihood there is of a change in the weekly rate, whereas the longer the duration of a nystagmus case (except in the cases of the older men) the greater is the probability of a reduction of the weekly rate or the cessation of liability. In the case of industrial diseases other than nystagmus (e.g. beat hand, etc.), it has been found that when such cases last more than 26 weeks they can generally be grouped for valuation purposes with the accidents.

OUTSTANDING LIABILITY FOR FIRST TWENTY-SIX WEEKS OF INCAPACITY

The cost of payments for the first 26 weeks of incapacity varies not only in different industries and in the various grades of employment in such industries, but also according to the system of insurance which may be in force. For example, if the cost of the first 26 weeks' compensation is borne by the member and the calls or premiums for the over 26 weeks' cases are assessed in relation to the number and character of such cases, there is a special inducement for the member to get the workmen back to work within the 26 weeks' period and this has the effect of reducing the compensation paid for the first 26 weeks of incapacity.

The first 26 weeks' cost relative to the accidents happening in a particular calendar year is not all paid in that year. A certain proportion (e.g. that relating to accidents occurring in the second half of the year) is paid in the following year. In cases where the workman returns to work within the first 26 weeks and later falls off work, payments relating to the first 26 weeks of incapacity may be made in the first or second year after the accident and in some cases many years afterwards.

The following figures, deduced from the experience of two Coal Trade Mutual Protection Associations, show approximately the proportions of the under 26 weeks' cost of the accident cases occurring in a particular calendar year which are paid in the year of occurrence of the accident and in future years:

Table 1

	Percentage of total under 26 weeks' incapacity cost paid in various periods (exclusive of industrial diseases)			
	Association 'A'		Association 'B'	
		%		%
Calendar year of occurrence	—	90·86	—	91·07
Year following that of occurrence	8·84	—	8·72	—
All later years (recurrences)	·30	9·14	·21	8·93
		100·00		100·00

It will be seen that in both associations the under 26 weeks' cost to be met after the end of the calendar year of occurrence is equivalent to, say, 10% of the amount paid for new cases in such calendar year (i.e. 9·14 on 90·86 = 10·06% and 8·93 on 91·07 = 9·81%). As this 10% is subject to a small rate of discount, the outstanding *under 26 weeks'* liability at the end of a calendar year *for that year's accidents* may be provided for by a reserve equivalent to 10% of the under 26 weeks' compensation paid in that year for the accidents in question.

The accumulated latent under 26 weeks' liability at the end of a calendar year for all accidents happening prior to the commencement of that calendar

year depends upon the length of time during which the system of insurance has been in force. Even when a system of insurance has been in force for the whole period of Workmen's Compensation legislation it has been found that an overhead percentage of from 1 to 1½% of an average year's amount paid for under 26 weeks' incapacity in respect of new cases in a calendar year would provide for the whole of the under 26 weeks' latent liability for cases arising prior to the commencement of the calendar year in question, so that in the case of an old-established fund a total provision of 11½% (i.e. 10% for the cases arising in the year just completed and 1½% for the cases arising in all previous years) would provide for the total future liability for under 26 weeks' payments relative to accidents which have occurred up to the date of valuation.

The above figures were obtained from the experience of two associations in which, owing to the special system of insurance in force, no case of under 26 weeks' incapacity is commuted for a lump sum: otherwise, an adjustment would have been necessary to eliminate the portion of the commuted value which would have represented the after 26 weeks' cost.

VALUATION OF CASES OF 'AFTER FIRST TWENTY-SIX WEEKS OF INCAPACITY'

The various methods which have from time to time been suggested for the valuation of the outstanding liability of Workmen's Compensation cases may be divided into two main classes:

(*a*) Methods which may be termed actuarial because they deal with the cases in groups, which groups are valued by applying a series of factors based upon the past experience of similar groups of cases.

(*b*) Methods which may be termed individual as they are based upon a medico-legal examination of the individual cases. Each case is examined in the light of its medical, legal and financial history and an estimate is made as to whether the case is likely to be temporary, partial and permanent or total and permanent, together with an estimate of the rates likely to be payable in permanent cases. Even when this method is adopted certain actuarial factors have to be applied in order to allow for the elements of mortality, commutation and interest which are involved.

In compensation trusts and other cases where the numbers are small the individual method is often found to be the most workable, but in the large associations it becomes almost prohibitive on account of the amount of time involved in the detailed examination of the cases.

An interesting method is that laid down by the Secretary of State for the calculation of the outstanding liability under the undertaking given to the Home Office by the Accident Offices Association, by which each subsequent year's cost of a particular calendar year's cases is expressed as a multiple of the amount paid in the year of account on claims arising in the year of account and outstanding at the end of the calendar year. The multiples used in the Accident Offices Association method, while they may be applicable to general Workmen's Compensation Insurance, would be unsuitable for many Mutual Associations, as is shown by the following recent experience of a Coal Trade Mutual Association:

Table 2. Compensation on account of the accidents arising in a particular calendar year paid in succeeding years expressed as a multiple of the amount paid in the year of accident for such of those cases as were in receipt of compensation at the end of that year

Multiples				
Year following that in which claims arose	Calendar year of accident			Comparative A.O.A. multiples
	1933	1934	1935	
First	1·8	2·2	2·0	$6\frac{1}{8}$
Second	1·1	1·4	1·4	$1\frac{7}{8}$
Third	1·1	1·3	1·1	$\frac{3}{4}$
Fourth	·8	·6	·6	$\frac{3}{8}$
Fifth	·6	·7	·6	$\frac{1}{4}$
Sixth and thereafter*	4·6	4·3	4·7	$\frac{5}{8}$
	10·0	10·5	10·4†	10

Notes. For the purpose of comparison with the A.O.A. multiples the above table includes the compensation paid for the first 26 weeks' incapacity in the year in which the claim arose and in subsequent years, and payments made on death in years subsequent to that in which the claim arose, although elsewhere in the paper consideration is restricted to payments made during incapacity.

* Calculated on basis of 75 % Post Office annuity values for cases existing at end of fifth year following year of accident.

† Omitting payments under the Supplementary Allowances Act, 1940.

Practical experience has shown that it is difficult to apply actuarial methods to the valuation of the outstanding liability for Workmen's Compensation cases, not only owing to the variable nature of the direct factors involved but also owing to the effects caused by variations in economic conditions, the variety of systems under which the risks are insured, and the administration of cases under different systems of insurances. The larger and more homogeneous the experience, however, the more it is susceptible to actuarial methods of valuation, and such methods can be the more effectively employed if the various factors of valuation are combined in such a manner that they can be readily varied from time to time as conditions alter.

In the case of the mining industry, which has a particularly high accident rate, it is possible to divide the experience into different classes containing adequate data from which to deduce average rates, and therefore actuarial methods can be more readily adopted than when a more heterogeneous experience has to be dealt with. This was demonstrated by R. G. Maudling in his paper on the 'Classification and duration of compensation claims in the mining industry' (*J.I.A.* Vol. LX, p. 251). Maudling classified the experience of a large Colliery Owners' Mutual Indemnity Association according to the nature of incapacity, age at date of accident and other factors and finally divided the cases into three main groups of incapacity which were each subdivided into three age groups, giving nine groups in all, the two first groups of incapacity including certain main medical classifications of accident cases and the third group including that of industrial diseases. Rates of discontinuance were taken out for each of these nine groups and annuity values calculated for

each year of duration, the duration being counted in complete calendar years from 31 December in the year in which the incapacity originated. The results gave (*a*) the value of £1 per annum payable during either total or partial incapacity, and (*b*) the value of £1 per annum during partial incapacity expressed in terms of all continuing cases whether of total or partial incapacity, and by means of these tables the outstanding liability was obtained.

In the discussion on Maudling's paper G. D. Stockman suggested 'that valuation factors might have been arrived at on the basis of a decreasing annuity on the analogy of the salary scale method used in Pension Fund Valuations'. Just as the s_x column in a pension fund enables the increase in average salaries from age to age to be ascertained, so the average amount of compensation payable over a group of cases can be expressed as a ratio which decreases according to duration, such decrease being due to certain of the cases becoming fit for light work and being therefore only entitled to a reduced amount of compensation.

Following another analogy from pension fund methods where the s_x column is used to give a ratio of increase rather than a definite amount of salary, the factor used is not a definite amount of compensation but a ratio of diminution of a standard amount, such standard being taken, say, as the initial full rate of compensation applicable to total incapacity in each case. For various periods of duration from date of accident the amounts payable for the outstanding cases in any particular group can be tabulated and expressed as a percentage of the amounts applicable to total incapacity for these cases, thus arriving at a percentage of diminution of the initial full rate of compensation for the period of duration in question. This percentage can then be used as a factor in the valuation of a decreasing annuity, the value of which annuity (allowing for rates of mortality, recovery, commutation, etc.) gives the present value of the future liability.

The following is an example of the employment of a method suggested in order to arrive at the net single premium required for each over 26 weeks' case of (*a*) accident, and (*b*) industrial disease at the date of its becoming a 26 weeks' case and for arriving at multipliers to be applied to the annual value of the weekly payments being paid to cases of various durations in order to ascertain the present value of the future liability for such cases. In actual practice separate premiums can be ascertained for cases falling within certain groups according to nature of injury and age at date of accident. In the following illustration for the sake of simplicity the only classification employed is in relation to age, i.e. the accident and industrial disease groups are each subdivided into three age groups, viz. under 31, 31–50, and 51 and over at date of accident, giving six groups in all.

The method is a 'year of duration' method and not a 'calendar year' method. The cases now being considered are all cases of over 6 months' incapacity and are traced through five periods, the first being the half-year of duration as a 6 months' case 0–$\frac{1}{2}$, then the years of duration $\frac{1}{2}$–$1\frac{1}{2}$, $1\frac{1}{2}$–$2\frac{1}{2}$, $2\frac{1}{2}$–$3\frac{1}{2}$, $3\frac{1}{2}$–$4\frac{1}{2}$, which brings one to the completion of $4\frac{1}{2}$ years from the cases becoming 6 months' cases, which in cases of continuous compensation is 5 years from the date of accident. The weekly payments (expressed as a ratio of the initial full rates of compensation) for each of these five periods are discounted to the date of becoming a 6 months' case (i.e. duration 0), and to the total of these are added the value discounted at duration 0 of the amounts paid to commute weekly payments during the $4\frac{1}{2}$ years and the present value

(i.e. discounted $4\frac{1}{2}$ years) of 75% of the Post Office Tabular Annuity Value of the permanent rate of compensation estimated then to be payable to the survivors at the end of the $4\frac{1}{2}$ years' period. This may be expressed in symbols as follows:

Let x be the average age last birthday at date of accident of the group (or on the average an exact age of $x+\frac{1}{2}$).

Then an annuity at age $(x+5\frac{1}{2})$ may be taken to be the average annuity applicable to the 'survivors' in receipt of compensation at the end of five years from date of accident. (*Note.* An arbitrary addition of $2\frac{1}{2}\%$ is added to the Post Office Annuity values as a reserve against recurrences of cases in which no rate of compensation is being paid at the end of the 5-year period and for other contingencies.)

Let t be the duration of the cases in excess of the first 26 weeks.

Let l_t be the number of cases in the particular group in receipt of compensation exactly t years after they became 26 weeks' cases, whence l_0 is the number of cases at the moment of their becoming 26 weeks' cases.

Let r_t, d_t and c_t be the number of recoveries, deaths and cases commuted respectively in the year of duration t to $(t+1)$.

Let $q_t^{(r+d)}$ be the composite rate of recovery and death during the year t to $(t+1)$, and q_t^c the rate of commutation during the year t to $(t+1)$.

Let s_t be the 'ratio of diminution', i.e. the proportion on the average of the initial full rate of compensation per annum payable during the year t to $(t+1)$, and s_t the similar ratio of diminution at exact duration t as a 26 weeks' case.

Let k be the number of years' purchase of the annual rate of compensation applicable to any particular group of cases paid for commutation of the future weekly payments.

[*Note.* As the first duration period is 0 to $\frac{1}{2}$ (i.e. only half a year), the above symbols are to be read as if for this particular period only, the interval is 6 months and not 1 year, e.g. r_0 and d_0 are the recoveries and deaths in duration 0 to $\frac{1}{2}$—not 0 to 1—q_0^c the rate of commutation in the period 0 to $\frac{1}{2}$, $\bar{s}_0$ the ratio of diminution for the period 0 to $\frac{1}{2}$; a payment at the rate of 1 p.a. involves the payment of $\frac{1}{2}$, etc.]

Let

$$\mathrm{D}_t = l_t v^t,$$

$$\overline{\mathrm{D}}_t = \tfrac{1}{2}(\mathrm{D}_t + \mathrm{D}_{t+1}),$$

$${}^s\overline{\mathrm{D}}_t = \bar{s}_t \times \overline{\mathrm{D}}_t,$$

$${}^s\mathrm{D}_t = s_t \times \mathrm{D}_t,$$

$${}^c\overline{\mathrm{C}}_t = c_t v^{t+\frac{1}{2}} k \bar{s}_t,$$

$${}^s\overline{\mathrm{N}}_t = \Sigma\,({}^s\overline{\mathrm{D}}_t + {}^c\overline{\mathrm{C}}_t) + {}^s\mathrm{D}_{4\frac{1}{2}}(a_{x+5\frac{1}{2}}).$$

Value of future liability per unit of annual rate of weekly payments being made at date of valuation $= \dfrac{{}^s\overline{\mathrm{N}}_t}{{}^s\overline{\mathrm{D}}_t}$.

Value of future liability per unit of initial full annual rate of compensation as at date of becoming a 6 months' case (i.e. the above value when $t=0$ multiplied by $s_0/s_{-\frac{1}{2}}$, or as $s_{-\frac{1}{2}}=1$, by s_0) $= \dfrac{{}^s\overline{\mathrm{N}}_0}{{}^s\overline{\mathrm{D}}_0} \times s_0$.

The above expression $\frac{{}^{s}\bar{N}_0}{{}^{s}D_0} \times s_0$ gives a 'multiplier' which, if applied to the sum of all the initial full annual rates of compensation applicable to the number of 26 weeks' cases in the group at the moment of their becoming 6 months' cases, will give the total future value of such cases, i.e. the net single premium for the cases in the group.

The expression ${}^{s}\bar{N}_t/{}^{s}D_t$ gives the valuation multiplier which, if applied to the sum of the yearly amounts being paid to cases of exactly t years' duration, will give the present value of such cases at exact duration t years.

Table 3 gives an illustration of the method of arriving at the requisite 'multipliers' from the various factors involved. The illustration applies to a group of cases of accidents (i.e. excluding cases of industrial disease) where the age of the workman at date of accident was over 30 and less than 51.

On the basis of this example, if there should be 100 cases of accidents to men who at date of accident were aged over 30 and less than 51 and whose initial full annual rates of compensation amounted to £6140, the present value of the future cost of such cases (without any loading for expenses, etc.) at the time of their becoming 6 months' cases would be

$$6{\cdot}815 \times £6140 = £41{,}844, \text{ equivalent to } £418 \text{ per case.}$$

If 2 years from the date of accidents, i.e. after $1\frac{1}{2}$ years' duration as 6 months' cases, there were 66 survivors of the original 100 cases quoted above who were receiving at that time total annual rates of compensation of £3120, the present value of the future cost of such 66 cases (without any loading) at the $1\frac{1}{2}$ years' duration point as 6 months' cases would be

$$10{\cdot}958 \times £3120 = £34{,}189, \text{ equivalent to } £518 \text{ per case.}$$

In the table multipliers are arrived at applicable to cases of exact durations as 6 months' cases of 0, $\frac{1}{2}$, $1\frac{1}{2}$, $2\frac{1}{2}$, $3\frac{1}{2}$ and $4\frac{1}{2}$ years. The cases of under 5 years' duration can thus be readily valued by sorting them into yearly periods of duration and applying the appropriate multiplier (i.e. the rate for duration $\frac{1}{2}$ to all the cases of duration 0–1, etc.) to the aggregate of the current yearly rates of compensation being paid to such group of cases at the date of valuation. If multipliers are required for valuing the cases in quarterly or half-yearly groups, values can be obtained by interpolation from the calculated results.

In the case of pension funds it is well known that the rates of mortality, withdrawal and retirement of one society should not be applied to another society which may have a very different experience; so in the case of Mutual Insurance Associations the rates of recovery, death and commutation will probably, owing to special conditions of accident risk, management, system of insurance, etc., vary considerably as between different associations. Although the rates used in the example are derived from the actual experience of a large association, they are merely given for the purposes of illustration of the suggested method.

Table 3. Giving an example of the calculation of present value 'multipliers' to be applied to the total annual amount of the weekly payments being made to a particular group of cases for various durations as 6 months' cases

Group II (i.e. accidents, age at date of accident, 31–50)

Duration as a 6 months' case (years)	Rate of recovery and death per annum	Rate of commutation per annum	Recoveries and deaths	Commutations	Total recoveries, deaths and commutations	Existing	Discount factor (i=·025)	$l_t v^t$	$\frac{D_t + D_{t+1}}{2}$	Average rate of diminution of initial yearly full rate of compensation in force during period	Present value of weekly payments	Rate of diminution of initial yearly full rate of compensation at exact duration t	$s_t D_t$
t	$q_t^{(r+d)}$	q_t^c	$r_t + d_t$	c_t	$r_t + d_t + c_t$	l_t	v^t	D_t	$\bar{D}_t$	$\bar{s}_t$	${}^s\bar{D}_t = \bar{s}_t \bar{D}_t$	s_t	${}^sD_t$
0	·140*	·015*	140	15	155	1000	1·000	1000	917	·855	392*	·900	900
½	·140	·085	118	72	190	845	·988	835	733	·795	583	·830	693
1½	·075	·125	49	82	131	655	·964	631	562	·755	424	·770	486
2½	·055	·125	29	65	94	524	·940	493	443	·740	328	·745	367
3½	·045	·050	19	21	40	430	·917	394	372	·730	272	·735	290
4½	—	—	—	—	—	390	·895	349	—	—	—	·725	253

Duration as a 6 months' case (years)	Present value of amounts paid in commutation of weekly payments in each period	Total of present value of amounts paid for commutation and weekly payments	${}^s\bar{N}_t$	Valuation multiplier to be applied to sum of yearly payments of compensation being paid to cases at exact duration t	Multiplier to be applied to sum of initial full yearly amounts of compensation at date of becoming a 6 months' case (i.e. duration 0)
t	$(c_t v^{t+\frac{1}{2}})\,(7·5\,\bar{s}_t) = {}^c\bar{C}_t$	${}^s\bar{D}_t + {}^c\bar{C}_t$	Σ (previous col.)	${}^s\bar{N}_t \div {}^sD_t$	$({}^s\bar{N}_0 \div {}^sD_0) \times s_0$
0	15 × ·994† × 7·5 × ·855 = 96	488	6815	7·572	7·572 × ·900 = 6·815
½	72 × ·976 × 7·5 × ·795 = 419	1002	6327	9·130	—
1½	82 × ·952 × 7·5 × ·755 = 442	866	5325	10·958	—
2½	65 × ·928 × 7·5 × ·740 = 335	663	4459	12·150	—
3½	21 × ·906 × 7·5 × ·730 = 104	376	3796	13·090	—
4½	Value of cases existing at end of 4½ years: 75% of $a_{\overline{w}+5\frac{1}{2}} \times {}^sD_{4\frac{1}{2}}$, loaded 2½% = 13·187 × 253 × 1·025, ($a_{\overline{w}+5\frac{1}{2}}$ being taken as $a_{\overline{46}}$ by the Post Office Annuity Table B 15, i.e. 17·583)	=3420	3420	13·517 (i.e. 13·187 loaded 2½%)	—

* Per ½ year. † $v^{t+\frac{1}{2}} = v^{\frac{1}{2}}$.

VALUATION OF CASES OF OVER FIVE YEARS' DURATION

In addition to the method employed in connexion with the undertaking given to the Home Office by the Accident Offices Association there are two statutory provisions with regard to the valuation of outstanding cases of over 5 years' duration which prescribe 75% of the Post Office Annuitants' Table as a standard of valuation.

In Section D, sub-section VII of the fourth schedule of the Assurance Companies Act, 1909, it is provided that in the returns which Insurance Companies make to the Board of Trade, particulars have to be given, inter alia, of the values of all outstanding cases of over 5 years' duration computed on the basis of 75% of the value of a life annuity purchased through the Post Office. This applies to all cases of over 5 years' duration, e.g. the case of a workman now aged 50 who had his accident exactly 5 years ago is valued at the same figure as that of a man now aged 50 who had his accident 20 years ago if they are each in receipt of the same weekly payment. This assumes that the temporary adverse 'selection' due to the high rate of recovery and mortality in the years immediately following the accident merges in 5 years' time into an experience which is at all ages and durations represented by 75% of the Post Office annuity values.

Under Section 13 of the Workmen's Compensation Act, 1925, where any weekly payment has been continued for not less than 6 months and the incapacity is permanent, the employer has the right, in the case of adults, to redeem the weekly payment (if such weekly payment represents the full measure of compensation to which the workman is entitled) by the payment of an amount equal to 75% of the Post Office annuity value. By voluntary arrangement, subject to the approval of the Court, agreements can be registered for smaller figures than 75% of the Post Office annuity value, and the majority of cases are commuted for amounts less than the 75% value.

With Section 13 of the Compensation Act in mind, it might be considered that 75% of the tabular value for all adult cases of over 5 years' duration is a maximum provision, as they could be compulsorily commuted on this basis. This is not necessarily so, as, if any material number of cases were commuted at the end of 5 years for 75% of the tabular value, there would be a strong tendency for workmen to refuse to commute cases for the smaller sums now accepted during the first 5 years of incapacity and the cost of the cases as a whole might thereby be increased. If the 75% provision is made for each case of over 5 years' duration the insurer would be solvent on a winding-up, as at the worst the cases could be compulsorily commuted for the amount provided, but if he continues to make the weekly payments during the lifetime of the workmen, the problem then becomes important as to whether or not the 75% reserve is an adequate provision.

In the paper given by William Penman, 'On the valuation of the liabilities of an Insurance Company under its Employers' Liability Contracts' (*J.I.A.* Vol. XLV, p. 101), a table was given (Table IX) in which the values 5 years from date of accident of an annuity on a life permanently and totally incapacitated according to French National Compensation Tables were found to be similar to those of 100% of the Post Office Table then in force (1911), but in the discussion on the paper the late Sir Alfred Watson questioned the basis of the French tables and disagreed with the opinion that a permanently injured workman who survived a year or two and recovered his health was likely to be an average

life. In addition to the point that permanently damaged lives are probably much worse than the average of the class from which they are drawn, there is the fact that the Post Office Annuitants are a very select class.

There are two other factors which have to be taken into account in the valuation of cases of over 5 years' duration, viz. that there may be, even after 5 years, a small rate of recovery, and the weekly rates in cases of partial incapacity may still be on the average subject to a small reduction. It is sometimes argued that as there can be no reduction in weekly rate in total permanent cases, these should be valued at, say, 100% of the table and partial permanent cases taken at some lower rate. It should be borne in mind, however, that while the weekly rate in total permanent cases does not vary, these workmen will be subject to a higher rate of mortality than the partial permanent cases.

It is probable, as Maudling pointed out in his paper, that even 10 or 15 years after the date of accident the mortality rates of permanently injured workmen are somewhat greater than the rates of the grades of the uninjured men from which they were drawn.

While there are these counteracting factors, experience shows that the initial 'adverse selection' (resulting in high rates of recovery and mortality) gradually diminishes in effect and the results later tend towards more normal annuity values. If, therefore, 75% represents the proportion of annuity values which, at the end of 5 years, can be taken to allow for the fact that the lives were 'adversely selected', higher proportions should be taken of the annuity values applicable to durations of over 5 years.

In order to allow for this fact, a useful formula is given by Mr J. H. Woodward in the *Proceedings of the Casualty Actuarial Society of America*, Vol. 1, No. 2, p. 125, for arriving at the percentage of the annuity table to be adopted in cases of over 5 years' duration, n representing the duration of the case from the date of accident, viz.

$$\frac{100-5\,(10-n)}{100}\,\bar{a}_{x+n+\frac{1}{2}} \quad [n \geqslant 10].$$

This results in cases of 5 years' duration being valued at 75%, 6 years at 80% and so on, 10 years and over cases being valued at 100% of the tabular value.

If this formula is used and a table based on a low rate of interest is adopted, the convenient method of valuing by means of the Post Office annuity values can probably be employed with safety.

WORKMEN'S COMPENSATION (SUPPLEMENTARY ALLOWANCES) ACT, 1940

The supplementary allowances payable under this Act, other than those in respect of children, can be valued in the same manner as the weekly payments under the principal Act, as all factors which affect the weekly payments correspondingly affect the general supplementary allowances.

The children's allowances, however, in addition to being subject to variation owing to the operation of the factors which affect the general allowances, cease on the child's death or on the attainment of 15 years of age. They can be valued in relation to the fathers' cases on the books or they can be valued directly as children's benefits.

For the purpose of the calculation of calls (or premiums), information is required as to the number and dates of birth of children under 15 existing at the date of the father's accident. When the Supplementary Allowances Act came into force data relating to children of disabled workmen were not then available. In order to estimate the number of children in respect of whom allowances would be payable for cases existing on 19 August 1940 the fatal accidents over a number of years were analysed and the number of children under 15 years of age in the families of these men at the time of the father's death was ascertained. As the age distribution of fatal cases is different from that of non-fatal accidents, the rates were taken out in quinquennial age groups. After comparison of these figures with the statistics from the National Health Insurance and other sources, rates were adopted which have, in the case of two Mutual Associations, proved to be only slightly in excess of the actual experience later obtained.

In these two associations the number of children estimated by applying these rates, after allowing for discontinuance due to the recovery or death of the father, commutation of the cases and for the fact that some of the children had, since the date of the accident, died or reached age 15, was 736 compared with 697 children actually brought on to the funds at 19 August 1940.

Although the average number of children per injured workman is required if it is desired to value the benefits per father's case and for calculation of premiums, it is perhaps simpler for valuation purposes to make the calculation directly in relation to the children in respect of whom payments are being made at the date of valuation.

The following method has been adopted in arriving at values of the children's annuities and is similar in principle to the method previously mentioned for the valuation of the ordinary weekly payments.

Eight groups of annuity values were calculated, separate calculations being made for (i) accidents, and (ii) industrial diseases (chiefly nystagmus cases), with four subdivisions of these groups according to the age of the father at date of accident, viz. (*a*) under 30, (*b*) 30–39, (*c*) 40–49, (*d*) 50 and over. In respect of each of these eight groups, values were calculated for each attained age of the child from 0 to 14 years and for durations of incapacity of the father from 0 to 14 years.

The durations were counted from the date of the case having extended over 6 months, i.e. duration 0 signified a case of exactly 6 months' incapacity whereas the father's age group was determined by his age as at the date of accident.

The factors involved in the calculation of the annuity values were (i) the rate of recovery of the workman; (ii) the rate of mortality of the workman; (iii) the rate of mortality of the child; (iv) the rate of diminution of the child's supplementary allowance (i.e. the average percentage of the full rate of £10·4 per annum payable at a given duration); and (v) the rate of interest.

Factors (i), (ii) and (iv) were obtained from past experience; for (iii) the average of the Male and Female English Life Table No. 10 rates was adopted and for (v) a net rate of interest of 2% was employed.

In arriving at multipliers for the valuation of the weekly payments under the principal Act, a rate of commutation was employed as one of the factors. No such factor has been allowed for in the calculation of the children's annuities, it being assumed that, as a consequence of the 1940 Act, there may be a tendency for fewer cases to be commuted and that if commutation is effected either the amounts paid in respect of the children's supplementary allowances

will not be much less than their actuarial value or the weekly payments under the principal Act only may be commuted, when the payment of the supplementary allowances would be continued.

It was at first intended to calculate the annuity values for certain ages and durations and to obtain the other results required from the calculated values by means of interpolation. It was found, however, that if the values were calculated separately for ages 0, 1, 2 and 3 for each duration, the values for ages 4–14 could be obtained to a sufficient degree of accuracy (·02 in the resulting multiplier) by a summation process from the calculations made for age 3. This was due to the fact that the children's rate of mortality had little effect upon the calculation as a whole and after age 3 the rate only showed a small variation from age to age.

As a result of the payment of the supplementary allowances there may be a tendency for the duration of the cases to be increased in the future. To meet this and as a general margin of safety over and above that allowed for in the rates adopted, an addition of 5% was made to the total of the values arrived at. This was an arbitrary addition which can be varied as the effect of the recent legislation is ascertained. It has already been found that there has been an increase (considerably more than the above 5%) in both the short and long duration cases as a result of the increased rates of compensation now payable.

Table 4. Specimen annuity values to be applied to the aggregate yearly amounts being paid in respect of children's supplementary allowances in order to arrive at the present value of the future liability of the children's supplementary allowances

Duration of accident as a 6 months' case	Accidents				Nystagmus			
	Exact attained age of child at date of valuation				Exact attained age of child at date of valuation			
	0	5	10	14	0	5	10	14
	Age of father at date of accident: under 30							
0	5·31	4·43	2·76	·83	4·26	3·95	2·84	·89
5	—	8·01	4·36	·97	—	5·79	3·66	·93
10	—	—	4·68	·99	—	—	3·90	·95
14	—	—	—	·99	—	—	—	·95
	Age of father at date of accident: 40–49							
0	7·05	5·71	3·33	·87	4·62	4·30	3·08	·91
5	—	8·11	4·48	·98	—	5·53	3·58	·92
10	—	—	4·53	·98	—	—	3·78	·94
14	—	—	—	·98	—	—	—	·94

The calculations were made in the above detail in order to estimate the effect of the various factors involved. In future calculations, fewer subdivisions for the annuity values will be employed and the benefits valued by grouping the children and using an average age for the group. The factor of the children's mortality can probably be omitted as its effect is small and by the omission of this factor the results would be on the safe side.

VALUATION OF 'SUSPENDED' CASES

The foregoing notes have dealt with the valuation of the outstanding liability of all cases where the workmen are in receipt of compensation at the date of valuation. There is, however, a source of liability in respect of cases for which compensation has been paid in the past but in regard to which no weekly payment is being made at the date of valuation, which is often referred to as 'latent' liability. If this latent liability should relate to incapacity for durations of over 6 months and under 5 years, it has theoretically been allowed for in the method already outlined as, in calculating the rates of discontinuance from past experience, any recurrences were treated as negative recoveries, the rate at each duration being made up of two factors: a rate of exit (the true discontinuance rate) less a rate of entry (the recurrence rate). The probability of cases of over 5 years' duration recurring has also been met by a percentage addition to the liability calculated with reference to the existing cases.

While the ordinary cases of recurrence may be taken to have been allowed for, in recent years there have been radical changes in the basic rates and other factors in miners' wages, and these have resulted in the cessation of compensation payments in a large number of cases of permanent partially disabled men who are employed on light work. These men may be dismissed at any time, there may be a temporary or a permanent closing of the colliery, the men may become totally disabled owing to natural causes and they will at some time reach an age when they cannot be employed. When any of these contingencies occur the men may be successful in obtaining a resumption of weekly payments of compensation and they thus form a serious liability to any Insurance Company or Mutual Protection Association covering mining risks.

A method which has been adopted to allow for this latent liability is to keep a record of all such suspended cases. They can then be valued on the basis of 75% (or some smaller percentage) of the Post Office Tabular Values of the annual amount of the weekly payments it is estimated they would receive if they were again to come on to the fund. This can in many cases be based on the rate applicable to partial incapacity which they were receiving prior to being given light work.

At the end of each year enquiries are made of the members in order to ascertain if any of the men on their suspended list have died, been certified as 'fully recovered', etc., such cases being then deleted from the valuation. Any men who during the year are given light work and become suspended cases are deleted from the Ordinary Valuation Lists and are transferred to the Suspended List. Conversely, any suspended cases who cease to be employed are transferred to the Ordinary Valuation List.

GENERAL OVERHEAD RESERVE

In the *Report of the Departmental Committee on Compulsory Insurance* it was suggested that Mutual Associations should provide funds as an additional reserve over and above the actuarially calculated amount. This is a question which relates not only to the non-fatal accidents dealt with in these notes but also to the other sections of Employers' Liability Insurance, i.e. fatal accidents, catastrophe risks, administration expenses, etc. If legislation were to be introduced for the compulsory re-insurance of catastrophe risks, it is possible that

some of the associations would have funds released which would form the nucleus of such a general reserve, and it should be remembered that on a winding-up such sums as are not required would provide a reserve for other contingencies.

As the calculations made under the previous headings refer to pure actuarial liability and do not include medical, legal and administrative costs, there should be a reserve to meet future working expenses under these heads.

If a general 'cushion' reserve is required over and above all normal actuarial estimates, it is difficult to suggest on what basis this should be calculated. It should clearly have some relation to the outstanding actuarial liabilities under all headings of cost. In the Departmental Committee's *Report* the following factors are mentioned: (1) the previous year's income, (2) the cases outstanding of over 5 years' duration in which partial compensation is being paid, and (3) the latent liability. It should be borne in mind, however, that some of the Mutual Associations have only given full insurance cover for a comparatively short period of years and their outstanding liabilities compared with their premium income is in a very different ratio from associations which have given full cover for longer periods. To meet such cases any 'cushion' reserve required might appropriately be a certain percentage of premium income plus some other percentage of actuarial outstanding liability. This would give some relief to associations with a large premium income but a small outstanding liability, and it would be meeting the criterion of solvency as such associations would naturally have a much smaller latent liability than associations whose full insurance operations have extended over a long period of years.

A practical point in connexion with any compulsory provisions as to general reserve is that such statutory reserve should be allowed to be included with the other actuarially ascertained liability and should not be treated as 'surplus' for taxation purposes.

ABSTRACT OF THE DISCUSSION

Mr E. J. Lancashire, in opening the discussion, said that since the last paper on the subject was read in 1929 the position with regard to Workmen's Compensation in relation to the coal mining industry had been changed appreciably by the passing of the Workmen's Compensation (Coal Mines) Act, 1934. That Act placed upon employers in the industry the responsibility of maintaining a contract of insurance or setting up a Compensation Trust Fund outside the control of the employer in order to meet the liability for compensation. It was not necessary to cover the first six months of incapacity in the case of a contract with a Mutual Indemnity Society, but if insurance was effected through the medium of a Workmen's Compensation Trust Fund it was necessary to insure the whole liability from the date of accident.

The author divided the methods of valuing outstanding liability into actuarial methods and medico-legal methods, and said that in his opinion the medico-legal method was more workable in small cases. Although he agreed with the author that in practice it was difficult to resist the temptation to use that method, it might prove dangerous, particularly for small cases. On the one hand, actuarial methods could not be applied blindly without reference to the individual cases; on the other hand, reports, certificates and descriptions of injuries could be misleading. For example, he had come across the case of a man who had suffered from an injured spine, which sounded serious but lasted only a few weeks, whilst a case of a bruised thumb, which sounded trivial, went on for a very long time and ended in an amputation.

Actuarial factors based on even broadly classified observations did at least show what similar cases were likely to cost on the average. The difficulty was that they were average factors, and with small numbers there might be wide dispersions from the average. The actuarial values should be regarded as minimum values and some additional reserve should be made for possible fluctuations above the average.

The speaker mentioned that he gathered from the paper that, if the insurer was not responsible for the first six months of incapacity, no reserve was made at the end of the year for cases occurring in the second half of the year which were still outstanding at the end of the year and which would become over 6 months' cases. If he had understood the position correctly it seemed to him that the outstanding liability was underestimated.

In considering the valuation of outstanding liability for the over 6 months' cases, the economic conditions, to which the author had referred, would probably affect not only the rate of claim and the rate of recovery, but also the rate of weekly payment, especially in partially disabled cases, because it was dependent on the level of wages. The intrusion of such economic factors complicated the calculation of suitable actuarial functions and particularly the author's 'ratio of diminution'. If ever there should come to pass a period free from fluctuations in wage levels, free from fluctuations in the volume of trade, free from the upsetting influence of legislation, and free from trade disputes, it might perhaps be possible to calculate ratios of diminution which would reflect the gradual reduction of the initial rate of compensation as cases passed from total to partial incapacity and, while partially incapacitated, as they became capable of carrying on more remunerative work. Such ratios would presumably diminish in the early durations and eventually increase, because, with increasing age, there would be less likelihood of the injured workman being able to perform even light work. But in view of the conditions existing in recent years he did not see how such ratios could be calculated. Whilst, therefore, the idea of a ratio similar to the salary scale used in a pension fund valuation sounded attractive, it seemed to him that the idea must break down in practice owing to the impossibility of calculating appropriate ratios. At the present time he would certainly prefer not to use such a ratio but to base the liability on the rate of compensation in force, making suitable additions to cover the possible future increase of the weekly payment which would follow a reduction of wages whilst on light work, and also the possible future increase on account of the workman reaching an age at which light work became impossible.

A further important point to be considered in relation to the ratio of diminution was whether enough light work could be provided. A colliery might go into liquidation or some of the pits might become exhausted. It seemed wrong to him that the resulting

increase in the cost of claims should fall on the employer, who should only be called upon to pay compensation on account of a man's impaired earning power. If the man could perform light work but could not find it either at the colliery or elsewhere, then surely he was qualified for unemployment benefit to make up his partial rate of compensation to a reasonable weekly sum. Nevertheless, by the terms of the Act, if he satisfied the Court that he could not secure light work, he could have his compensation raised, and that factor should be taken into account.

The main difficulty in valuing outstanding claims, and hence in calculating a proper premium to cover the risk, was due to the fluctuation of the amount of the weekly payment during partial incapacity which arose from the fluctuation of wages. It seemed to him that variations due to a change of wage level were a business risk rather than an insurance risk. Similarly, the ability or willingness of an employer to provide light work was hardly a matter to be taken into account in insurance. He wondered whether a more satisfactory method might not be to insure on the basis of the full rate of compensation without diminution. The insurer would undertake to pay full compensation so long as the man was medically unfitted to resume his normal occupation, but whilst the employer could provide light work he would be credited with the difference himself, which would help to offset the heavy premium which would be necessary.

In cases of nystagmus, work on the surface was often thought to be beneficial to the man. There was a body of opinion, however, which suggested that light work, far from helping recovery, led to a prolongation of incapacity. If that were true, it seemed that future development must be in the direction of securing the rehabilitation of the injured workman under proper specialized medical supervision. The idea of insuring the full rate of compensation in those circumstances was not quite so fanciful as it might at first appear, because if the man were to undergo treatment he must receive full compensation pay during the period of treatment.

He thought that actuaries should take an interest in the causes of accidents, as they were in a position to review all the accidents at one time and so to detect trends which might escape the notice of the management dealing with isolated accidents.

At a meeting of the Royal Society of Medicine the effects of Workmen's Compensation in prolonging invalidism were summarized as follows: (1) The Toxins of the man's imagined rights (referring to the man's belief in a right to a substantial lump-sum payment), (2) the Pest of the lump-sum settlement, (3) the Curse of under-nourishment, (4) the Plague of light work, (5) the Scourge of over-treatment. Those were strong words, but they were not unsupported by evidence. Some of the points fell within the sphere of the doctor or sociologist rather than the actuary, but he had referred briefly to the 'Plague of light work' and he wanted to pass to the consideration of the 'Pest of the lump-sum settlement'.

The Workmen's Compensation Acts provided that the injured workman should have a weekly payment, and it did not seem to be in keeping with the purpose of the Acts that a man, and especially a seriously injured man, should be able to take or be forced to accept the commuted value of his compensation payments. He understood that in some countries the commutation of compensation payments was entirely prohibited.

If commutation took place it should be on the basis of a fair estimate of the value of the future payments having regard to current medical reports. Commutation cases were by no means necessarily average cases, and settlement for less than the amount of the actuarial reserve did not necessarily mean that there was a profit. In practice, however, such transactions appeared to result in a profit to the insurer.

The tendency in recent years had been for commuted values to increase, and it was likely that the upward tendency would continue, even if it were not given further impetus by new legislation. The increase was illustrated by figures showing the number of years' purchase paid by a Mutual Indemnity Association in commutation cases during each of the years 1936–40:

1936	4·3	1938	6·2	1940	7·3
1937	5·6	1939	6·3		

Commutation was a withdrawal benefit, and as such must always be regarded critically. He felt that there was a strong possibility that the anticipated profit might not be realized, and he therefore preferred to ignore that factor in the valuation and to let such profits emerge as they were actually realized.

As to the valuation of cases of over 5 years' duration, it was probably the case that the rate of recovery was small, but the rates of pay in permanent partial disablement cases were still liable to fluctuate even after five years, as the experience of recent years had shown in a very marked degree. By the time the first five years had elapsed the ratio of diminution had ceased to operate and as the values were based upon the actual weekly rates in force the author's method assumed that the rates would not be appreciably modified in future. The suggested further step of increasing gradually the proportion of the Post Office annuity from 75 % to the 100 % level could be regarded as providing for the approach to normal mortality as duration increased, and also for a possible increase in the weekly payment in later years.

There was a short section at the end of the paper dealing with valuation of 'suspended' cases. Suspended cases might hide a serious liability. The cases which had previously drawn compensation could, he thought, be divided into the following categories: (1) the men who had been certified as fully recovered (it was of interest to note that there had been an increase in recurrences during the last two years), (2) the men who were back at work but had some permanent disability, such as permanently stiff fingers or limbs (he thought such cases would have little difficulty in sustaining a renewed claim, probably at a higher rate of compensation, should economic conditions result in a shortage of employment), and (3) the men who were still on risk, but whose rate of payment at the moment was *nil*.

In the first category the prospect of renewed claims was probably fairly remote, in the second category not so remote, and in the third it might only be a matter of time before claims had to be met.

He would suggest for consideration that the liability for the first group should be included in a general reserve related to claims after 5 years' duration (the cases under 5 years' duration had already been dealt with by the author's negative recoveries). In the second group perhaps there could be a scale of fixed reserves according to the nature of the injury. In the third group the employees were merely in receipt of the lowest possible rate of compensation, and in essence they were no different from other cases receiving a few pence per week. On practical grounds he thought it would be easier to leave such cases on the 'live' register until they were certified by the doctors as having recovered, especially as in some collieries the weekly payments were liable to fluctuate from week to week in sympathy with wages, so that a person on the 'live' register one week might pass to the suspended list in the next week.

The method of valuation suggested by the author gave, of course, satisfactory reserves but his method of dealing with the *nil* cases affected the rate of recovery. If the man went on to the 'suspended' list he presumably appeared in the rate of recovery, and if that were so the rate of recovery took on a special significance as it was then related only to the evaluation of the benefit and not to the medical condition of the workman. If that course were adopted the logical procedure seemed to be to ignore the medical condition and to use a rate of claim which should be an amalgam of the ordinary rate of recovery and the author's ratio of diminution. A rate of claim was, however, the actuary's last hope, to be avoided if possible.

He wished to refer briefly to two other matters. The first was silicosis. The author did not mention it in the paper, probably because it was not found in the collieries with which he was concerned. But it was important in dealing with a colliery where the conditions were conducive to the disease. Hitherto the chances of recovery had been very slight, and although the duration of the cases was relatively short the cost was heavy because full pay might be claimed all the time. The prevalence of silicosis in a colliery rendered unsuitable for use, without appropriate modification, facts drawn from the experience of another colliery.

The second point concerned the age limit. If after the war an increase in the State pension were to materialize, then it would appear to be convenient to stop compensation at the pension age, and to let the man draw his pension. There should be some limiting age, he thought, but, of course, it was necessary to provide an alternative benefit for the man. With an adequate pension there would no longer be any need for compensation, the liability for which should cease as that for sickness benefit ceased.

Mr W. F. Marples agreed with Mr Lancashire that the question of diminution of compensation with duration since the accident tended to fade into insignificance when

the difficulty of determining the payment to be valued was considered. The annual payment in the case of total disablement was fixed, subject to review procedure, but that of a partially disabled man varied considerably because it was dependent on the difference between his pre-accident and post-accident earnings and hence was greatly influenced by the degree of activity in the industry.

The use in valuation of the current payment was fraught with considerable danger, in that it not only undervalued the real liability but produced extreme irregularity in reserves. The problem had been solved partially in certain cases by using an estimate of the compensation which would be payable if the man were performing light work for, say, four shifts a week, a method which had the merit of bringing out consistent valuation results and a not unreasonable estimate of the real liability. The payment so adjusted did not take into account any increase in the compensation which might be taking place under Section 11 of the 1925 Act, under which a man could claim to have his pre-accident earnings reviewed if the earnings of a fit man in the same occupation were more than 20% higher than when the disabled man was similarly employed.

When the payment for valuation had been determined the question of the annuity value had to be considered. Section 13 of the 1925 Act prescribed the basis of redemption of compensation payments, namely, 75% of the Post Office annuity value, which might be regarded as the minimum value. But an estimate had to be made of the actual value of the continuing payment, determinable by death, redemption or recovery. That value depended on the actual experience of the company concerned and might vary considerably in different parts of the country. *A priori,* there was no reason to suppose that the Government annuitants' table was actually suitable for the valuation of compensation payments for disabled miners, however satisfactory it might be as a uniform statutory redemption basis. The position should at least be examined carefully before adopting a simple rule, such as that suggested by the author, by which a reserve of the full Post Office annuity value was built up.

The speaker gave details of mortality and commutation experiences relating to miners in various parts of the country with over 3 years' duration of disability. He said that if those experiences were employed to produce annuity values the results would differ widely, and that showed in his opinion how inequitable the operation of a uniform basis of valuation might be, particularly when it was remembered that premiums and the corresponding calls for Mutual Indemnity Associations were based on the valuation results.

Finally, he stressed the need for information with regard to miners' disablement. It had long been a matter for regret that so little information was available with regard to the incidence of the cost of compensation in the mining industry because of the absence of what should be obtainable from statutory returns.

Mr Guy Johnson (a visitor) said that he did not think he ought to allow Mr Lancashire's remarks concerning lump-sum payments to pass without comment. The subject had been investigated by a number of commissions and committees during the last twelve years, and they had failed to agree whether the lump-sum payment was desirable. No general agreement could be gathered from the evidence given on behalf of the insurers, the employers and the trade unions; the Accident Offices Association had been neutral on the subject.

The author had stated that the cost of payments for the first 26 weeks differed with the system of insurance in force, and that where there was a special inducement to get the workman back to work within the 26 weeks' period the effect was to reduce the compensation paid for the first 26 weeks' incapacity. He hoped he had misunderstood the significance of that statement, which was rather disturbing. He doubted very much whether the author would find many people to agree with the idea that the insurer could materially affect the time which would elapse before the man returned to work.

A similar point was raised later, where the author said that the increased compensation under the Workmen's Compensation (Supplementary Allowances) Act had led to an increase in both the short- and long-duration cases. He would like to know how far that was a general experience. He would have expected to find that the increased wage levels exerted a stronger influence, and that therefore there would be a tendency to return to work quickly. He agreed that the cost of the first 26 weeks varied with different

industries, and that the composite offices had lower costs because they dealt with a larger proportion of lighter injuries.

In considering the factor used in the undertaking to the Home Office it should be remembered that the factor was not applied to the business of any one company but to the total of the sums reported by all the members.

He proceeded to describe the method by which he understood that the undertaking had been devised by the late Sir Alfred Watson. For the first three years of the undertaking the factor was calculated by finding for the second, third and fourth years previous to the account the proportion of payments on account to actual payments in respect of outstanding claims, plus estimates for claims outstanding at the end of the year of account. To the figures so ascertained a margin for safety was added. It was found that for three years the factor produced was approximately 10 %, and that figure was adopted from 1927 onwards and had been rather successful. The last year which could be taken was 1936, and taking the nine years 1928–36 there had been an excess in every year but one. The average figure was about £63,000 in each of those years, and as the amount of reserve averaged rather over £1,600,000, there was an average excess of about 3·86 % of the reserve. There had been fairly wide fluctuations from year to year, partly due to the fact that the figures reported by the members were the amounts which they had paid to reimburse the employer. That was subject to rather undue external influences. For example, air raids in the winter of 1940 apparently led to delay in presenting and settling accounts, and there was probably less brought in than there should have been.

The Supplementary Allowances Act had affected weekly payments more than other payments, and such payments formed the bulk of what were called the 26 weeks' payments. But it had not increased the payments, other than the weekly payments, to the same extent—it had hardly affected them at all. Common law claims and medical expenses had not been affected, and that meant that the figure which had been multiplied had been increased out of proportion to the total claims which had had to be paid.

Something should be said about the author's remark that uniformity of method was desirable. He would not say that that was an assumption with which he would be prepared to associate himself. It seemed to him that the criteria of the desirability of uniformity were that the result should be easily produced, that it should be better when it was produced, and possibly that the result should be such as enabled a comparison to be made between one method and another. Better results depended upon the extent to which the formula was elaborated and particularly the extent to which it was kept up to date. There were so many changes in the labour market and in general economic conditions that the amount which would have to be paid undoubtedly varied during quite short periods, and as the effect of any system could not be checked in less than 5 years the formula was likely to be out of date.

He did not know how far elaboration would be possible in a composite office. To attempt to arrive at multipliers, and more particularly to keep them up to date, would undoubtedly involve an enormous amount of work.

As regards the comparability of reserves, he thought that the attraction was probably more apparent than real. Such comparisons could usefully be made only by persons versed in the art of making them. The ratio of reserves to premiums of one company could always be compared with that of another, and, as was probably more significant and important, any change in the ratio of reserves to premiums made by a company from one year to another could be noticed and an explanation sought.

The undertaking basis was not in fact an alternative, but a method which was applied to all companies or to a large group of companies. It had proved to be very satisfactory from that point of view, but it was not established to provide adequate reserves. It would be fair to say that it was designed to ensure that the amounts which were brought into account on the reserves were adequate, but not more than adequate, when striking a profit for that year. It seemed to him on balance that the case for uniformity as compared with the individual method had not been established.

Mr D. A. Porteous said that the author had referred to the division of cases between accidents and nystagmus, and had suggested that industrial diseases other than nystagmus might generally be grouped for valuation purposes with accident. He would probably not adopt that course without investigation. In particular, cases of silicosis,

if numerous, should certainly be investigated as they presented some distinctive features.

He had been specially interested in the reserve factors on the basis adopted in valuing the outstanding liabilities of the tariff offices. The Accident Offices Association factors were, of course, used to obtain estimates of the aggregate outstanding liabilities of the accident offices as a whole and were not necessarily suitable in an individual case. It was interesting, however, to find that the total factor based on the experience of the author's Association agreed so closely with the A.O.A. standard factor, although the constituent parts for the various durations were very different. A possible explanation of the difference between the factors for the first year might be a greater tendency on the part of the accident offices to clear cases off their books by payment of the lump sum. The factors based on the actual experience of the claims which arose in 1933 and 1934 were about 9·5; 1935 produced 10·2, but that was affected probably to a small extent by the supplementary allowances which started in 1940. He had examined the A.O.A. results to see whether they showed any trace of the emergence of latent liability during the period of heavy unemployment in the years 1931–33. No such result appeared, however, as the payments made in those years on the claims which arose previously produced factors which, if anything, were rather smaller than usual. It might be that the point was not so important in the large aggregation of relatively light risks with which the accident offices dealt.

The author referred to the proportion of payments for the first 26 weeks of disablement which was outstanding at the end of the calendar year, and said that the figure could be taken at about 10 % of the amount paid for new cases. No direct comparison on that point could be made with the A.O.A. figures, but in recent years the amount spent in the year on new claims still in force at the end of the year was 16·5 % of the total amount of the new claims for the year. That included lump-sum payments and death claims. The proportion had shown a rising tendency; in 1924–26 it was only about 12·5 %. As the proportion was to some extent linked with the reserve factor it would be of interest to compare that feature of the A.O.A. experience with the corresponding results of the coal industry if the author could conveniently provide the figures.

Mr S. Townsend (a visitor) said that a reference had been made to the likelihood that a great deal of work would be saved if some actuarial method were found for the valuation of outstanding claims. One of the practical difficulties, however, was that by the time the data necessary to arrive at the method had been obtained, the data were out of date.

The factors governing the amount of claim payments changed very quickly. Since the Factories Act of 1937 the number of common law claims had increased very considerably. Recently a concession had been made by employers and insurance companies with regard to election. It had been agreed that for a period of three months workmen would not be bound by their election, and that they could take Workmen's Compensation without losing their common law rights until the end of that time. That privilege was very important in estimating the cost of a claim. He thought that the Home Office calculation was a method which was more likely to fit the case than any other. He agreed with Mr Lancashire that a reserve for contingencies was required; in other words, if a factor was to be obtained it must be calculated on a broad basis. He thought that the Home Office factor was of such a nature and that it had proved in its results to be very satisfactory, bearing in mind that it was calculated on a very large figure and that offices varied in size, so that it obviously could not be applied to each one. In the examination of the figures of several companies he had noticed that there seemed to be a relation between the amount which was paid each year on account of outstanding claims and the amount which was finally paid; it varied with different companies, but the results suggested that there was some underlying principle. The estimates of the companies concerned were made by the medico-legal method, taking each case separately, and that method of arriving at the figures was in his opinion unquestionably the most accurate.

Mr B. C. Lucena, F.F.A., said that the author dealt chiefly with Mutual Indemnity Associations and particulars had been given concerning the insurance of the risks with

which those associations were concerned. But among the minority were the trust funds of individual collieries, which presented additional problems to the actuary. A trust fund established under the Workmen's Compensation (Coal Mines) Act, 1934, required an estimate of the future cost of all claims which would arise during the ensuing 12 months or the new claims liability. The present paper did not cover that point, but any method which the author had devised would be very valuable to the actuary. In two collieries in Staffordshire it was found that over a period of years before the war the number of new claims varied fairly consistently with the tonnage of coal raised, and on that basis it had been possible to estimate the number of new claims and the expected cost. But a disturbing feature during the last 3 years had been a rapid and rising increase in the number of claims per thousand tons raised. Before the war the averages of both collieries were rather below the figures given in Maudling's paper, but by 1941 both averages had risen by about 50% over the 1938 figure. It was also interesting to note that in the colliery which had the higher number of claims the initial expected duration of claim was the less. That increase was not apparently confined to Staffordshire pits, and it would be interesting to know whether the author had the same experience, as both the outstanding and the new claims would be affected, and it was to be expected that the number of claims due to accident would tend to fall when wages were high. Was it more difficult working conditions or the older age of the miners concerned which led to more frequent accidents? Was that borne out by the experience of others? In the case of the men with dependants, the increase due to the supplementary payments granted by the Act of 1940 was proportionately greater than the increase in wages, and it was recognized that the smaller the margin between wages and compensation the more frequent and prolonged would the claims tend to be, so that some increase in the duration of claim might also be expected.

His experience with regard to latent claims was that they seemed to be more important than they were a few years ago; in fact, about one-third of the whole reserve had to be made on account of latent claims.

In the valuation of a trust fund it was necessary to allow for compensation from the outset, and so the duration of claims was divided in separate weeks for the first 26 weeks, then 6 months to 12 months, and thereafter in completed years, and it was found that about one-half of the claims had a duration of 4 weeks or less. Commutations were few in the case of the Staffordshire collieries, and for the purpose of calculating annuities were considered as extending the duration of the claim by the number of weeks' payments represented by such settlements. The resulting values for over six months' were much less than the figures given by the author, which was evidence in support of what had been said about the different conditions in different parts of the country.

On the question of valuation by the medico-actuarial basis, he thought that the method might be dangerous, because to make a proper estimate the actuary sometimes needed also to be a doctor and a lawyer.

Mr G. D. Stockman said that if no attempt were made to obtain a law for the basis of reserves there was no prospect of getting nearer the truth. In exceptional times the procedure should be to go back to the most stable time that could be found, to recognize that it could not be applied without adjustment, and to make the best adjustment possible in the light of what was known about current conditions.

In dealing with the difficulties arising from latent liability, it appeared from what Mr Lancashire had said that he took a cautious view with regard to each aspect of the problem, and fearing that the reserves brought out might still be inadequate he added a substantial margin for contingencies. That course appeared to the speaker to be a travesty of a valuation. What should be done was to try to assess accurately the various factors which came into the calculation, and if any item remained uncovered, to make a reserve for that specific liability.

Absolute uniformity of method was unlikely to be obtained while there were different policies with regard to lump-sum settlements. It seemed to him that the basis of all methods implicitly involved something like a salary scale, and, with a scale, variations could be made in valuing the liabilities of different associations, the same methods being used but the weight of the different factors altered. In that way a dependable method of valuation would be reached and its results could be compared with the results of another valuation.

One speaker had mentioned the handicap which arose from the lack of published statistics with regard to workmen's compensation. The Committee on Compulsory Insurance was similarly handicapped and although it obtained quite a useful volume of information for its own purposes, unfortunately that information could not be published because it was obtained on the understanding that it was solely for the information of the Committee. He supposed that in due course there would be amending insurance legislation, and by that time the Mutual Indemnity Associations might themselves recognize that it was not to their advantage that there should be no published information concerning the way in which their business was being run.

Mr William Penman said that he had a certain amount of sympathy with what Mr Stockman had said. It would be useful if there were in existence something in the nature of a standard for the valuation of claims, even if it were no more than a standard by reference to which the effect of variations of basis might be measured.

He agreed with other speakers that the actuary when dealing with the outstanding liability for a trust fund ought to visualize what the position would be if the colliery went into liquidation and the trust fund had to meet its liabilities without any further support from the colliery. It was quite certain, in that event, that light work would be dealt with in a totally different way, for the successor to the liquidated colliery company would not be greatly interested in providing light work for men injured under the previous regime. So far as trust funds were concerned—and it would presumably apply also to Mutual Associations—the actuary should visualize what the compensation would be if that support were withdrawn, and he should make his estimate of liability on that assumption.

He did not think that the actuary making the valuation was very much concerned with the ethics of lump-sum settlements. Some lump-sum settlements were beneficial to the injured workman and others might be prejudicial, but, in any event, he thought that it would be wrong for the actuary to bring into his calculation any estimate of future profit on lump-sum payments. All that would happen would be that, as a result of payments of that description during the year, a portion of the assets would disappear from one side of the account and a portion of the liability from the other.

The President said that the principles underlying the work which the author had brought forward were familiar to them all, but the practical application of the principles to the problems considered was a matter with which comparatively few actuaries had to deal. In spite of that a good discussion had taken place, to which both actuaries and non-actuaries had contributed, and he was quite sure that the author would be gratified by the reception given to his paper, even though he might not have agreed with all that had been said.

They were all alive to the importance of not underestimating liabilities for outstanding claims in casualty business, and they remembered the opinion of the Cassel Committee that such underestimation had been an important factor in the failure of certain companies in years gone by.

But if that was important to the companies it was equally important to the Mutual Indemnity Associations, which, as the author had pointed out, handled something like 80% of the total claims for Workmen's Compensation in the coal industry. Unfortunately, very little was known about the financial position of those associations. Many of them no doubt were in good hands, well managed and financially sound, but others might not be. He entirely agreed with previous speakers that it was a matter of regret that legislation on the lines proposed by the Cassel Committee, and previously by the Clauson Committee and the Holman Gregory Committee, had not been passed. Actuaries were concerned to see that the beneficiaries of the funds they administered were properly protected and one of the strongest safeguards was publicity. It was a sad criticism of their parliamentary machine that a system condemned so long ago should still remain in existence. After the war one of the many urgent tasks of Parliament would be to find some means of dealing with legislation, which was to a large extent non-controversial, without the interminable delays which had been experienced in connexion with insurance.

Mr Harold Boag, who was unable to attend the meeting, has sent the following communication:

Mr Lancashire expressed the view that the medico-legal method might be dangerous, particularly for small cases. Where the numbers are susceptible to average I prefer the actuarial method, but I would employ the medico-legal method if the number of cases were small and the experience heterogeneous. In the case of an experience of moderate extent I employed a combination of the two methods as a check upon my results. I estimated the amount payable at the 5-year duration point by an examination of each individual case in the light of its medical and legal history and applied rates of recovery, mortality, commutation and discount to the aggregate of such estimated amounts. These results, together with estimates of the discounted value of the weekly payments and the amounts to be paid in commutation up to the 5-year point gave the required reserve values. If practically the same rates of recovery, etc., are used as are employed in the calculation of the actuarial 'multipliers', then the main difference between the two methods is that in one case an aggregate of individual estimates of the reduction in the weekly rates is used instead of a calculated 'ratio of diminution'.

I agree with Mr Lancashire as to the difficulties introduced into the problem of valuation by possible changes in economic conditions. In addition to the special effects on the rates of claim, recovery and weekly payment there is the effect of economic conditions reflected in the rate of interest (and consequently the Post Office Table to be employed) and depreciation of investments. It must be remembered, however, that variations in economic conditions would affect the results of the valuation whichever method were employed, and I do not think this is an argument against a conservatively arrived at 'ratio of diminution'. Also the ratio of diminution is expressed as a percentage of the initial full rates of the actual cases to be valued, and part of the variation (i.e. that due to high or low full rates of compensation) is therefore allowed for in the calculation.

I am particularly interested in Mr Lancashire's remark that the willingness of an employer to provide light work is hardly a matter to be taken into account in insurance. The two Associations for which I act have endeavoured to meet this point by giving a rebate to their members of 75 % of the gain which the Associations make owing to the provision of light work.

With regard to the treatment of lump-sum payments in cases where a policy of commutation is consistently adopted, it would lead to a lack of faith by the layman in the results of the valuation if the gains under this head were to be entirely ignored. One of my Associations commutes from 50 to 75 % of its 6-months' nystagmus cases and about 30 % of its 6-months' accident cases, and to ignore the fact of such commutation would undoubtedly over-estimate the liability. On the other hand, in view of the fact that recent and projected legislation may adversely affect the number of commutations, it is certainly wise to adopt very conservative rates for this factor.

I think it is true that in recent years there has been a tendency for the number of years' purchase paid in commutation cases to increase, and this view is supported by the experience of a north-country association in which the figures for the five years 1936–40 were 3·9, 4·3, 4·8, 4·4 and 5·2 respectively. Care should be taken, however, in interpreting figures derived from overhead averages relating to the coal industry. The number of years' purchase depends chiefly on the age and the nature of the case, e.g. in our Associations accident cases of about age 40 are at present commuted for approximately seven years' purchase, while nystagmus cases of all ages average about three years' purchase. A variation in the age distribution or the proportion of nystagmus cases to the whole may, therefore, account for a change in the average apart from any general tendency of variation in amount.

Mr Lancashire has observed that the rate of recovery would be affected if the *nil* cases are included in the rate of recovery. In our statistics they are so treated on the 'actuarial cards', but when rates of recovery are being calculated for premium purposes the suspended cases are 'written back' and the rates are also adjusted for deaths and recoveries amongst the suspended cases.

Cases of silicosis, being of rare occurrence in the north of England pits, have not been treated as a separate class, but if they were of more frequent occurrence they would undoubtedly, as suggested by Mr Lancashire and Mr Porteous, require special treatment. These remarks will probably also apply to pneumokoniosis when this disease is brought within the Workmen's Compensation Acts.

Mr Marples mentioned a method in which an adjusted amount is valued instead of the actual payment. In some respects I follow this method as, owing to the allowance to our members of 75 % of the gain due to the provision of light work, I value in such cases not the actual payment but the actual cost to the Association. An increase in the *nil* cases is allowed for by the inclusion of the amounts provided for the suspended cases and part of the contingent liability in cases where small rates are being paid by the above adjustment of the present actual rate, but it is probably wise to make some further overhead reserve for the contingent review liability.

I have found a good approximation to the death-rates in cases of age at date of accident up to age 50 to be the English Life Table No. 10 rates plus the following addition according to the duration as a 6-months' case, i.e.

Duration as a 6-months' case	Addition to E.L.T. rate for attained age	Duration as a 6-months' case	Addition to E.L.T. rate for attained age
0	·0114	5	·0031
1	·0092	6	·0020
2	·0073	7	·0010
3	·0057	8	·0003
4	·0043		

The rule of working up to the full values by a standard table has an actuarial justification, as for later durations the rate of recovery tends to disappear and the special accident rate of mortality merges into that of a normal experience.

Mr Johnson is surprised that a different form of insurance applying to the under and over 6-months' cases affects the incidence of the compensation experience. This may be due to a number of causes, one being that there may be only a limited amount of light work available and the employer will naturally give it to men whose compensation would otherwise cause the case to exceed the 6-months' period, when a further sum would become payable. The immediate effect of the Supplementary Allowances Act according to the experience of the north-eastern districts was that the duration of cases increased, and I believe this applied to a number of the other districts. This was expected as it is generally found that the higher the proportion which any benefit (whether it is a Friendly Society benefit or a compensation payment) bears to wages, the greater the cost of the claims.

In Mr Johnson's criticism of attempts to obtain uniformity, a distinction should be drawn between uniformity of method and uniformity of the factors employed. The Cassel Committee suggested that it should be an obligation 'upon Mutual Associations to strengthen their reserves to some minimum standard', and it was visualized that the Advisory Committee should lay down certain methods of valuation.

I think Mr Porteous is correct in attributing the difference in the first year's multiple between the A.O.A. figures and the Coal Trade example in Table 2 of the paper to the fact that the Accident Offices commute their cases at an earlier stage than the majority of the Coal Trade Mutual Associations.

The figures asked for by Mr Porteous, viz. the percentage which (*a*) the amount spent in the year on new claims still in force at the end of the year is of (*b*) the total amount of the new claims for the year relative to the Coal Trade Experience given in Table 2, are as follows:

Calendar year of accident	Percentage (*a*) of (*b*)	(*b*) expressed as a multiple of (*a*)	(*b*), excluding death claims, expressed as a multiple of (*a*)
1933	12·2	8·2	5·4
1934	12·8	7·8	5·1
1935	13·4	7·5	4·9

If the amount of (*b*) is expressed as a multiple of (*a*), it is then in the same form as the multiples in Table 2 and comparisons can be made of the total cost expressed as a multiple of (*a*), i.e. the cost in the year of account plus all future cost.

In the coal industry the death claims form a larger proportion of the whole cost than in the more general experience of the Accident Offices and in the 'multiple' form of comparison the death claims can be omitted in order to show the variation in the non-fatal cost alone.

An increase in the multiples, however, does not necessarily mean an increase in cost. The multiple is a relation to a variable yearly standard. If the amounts of (*a*) and (*b*) both increase in a similar proportion (which is probable in a time of increasing cost) the multiple would be constant.

Mr Lucena mentioned the disturbing feature of the increase in the number of new claims compared with the tonnage raised. I give below the corresponding figures for our two Associations:

Year	No. of new claims per 100,000 tons raised	
	Association 'A'	Association 'B'
1937	58·33	52·02
1938	59·06	52·76
1939	55·05	52·98
1940	59·26	61·31
1941	72·84	77·17

A word of warning may be necessary as to the use of the tons raised as a divisor in coal trade experience. The development of mechanized mining results in a larger number of tons being raised per person at risk. For this reason I use different divisors according to the special purpose in view, e.g. tonnage raised is useful when the question involved is the commercial cost of the accidents, man-shifts worked when the true accident incidence is involved, persons employed when the social effect of the accidents has to be considered, and wages paid when a comparison is required between the premiums charged by Insurance undertakings.

As a comparison with Mr Lucena's statement that latent liability provision forms one-third of his total liability at 31 December 1941, the figures from my own valuations were 23 % in the case of one Association and 28 % in the other, but both these percentages will be increased at 31 December 1942 owing to the large number of cases which have been transferred to the suspended list during the current year.

I am glad that Mr Stockman defended the principle of methodical valuation in place of what might become haphazard estimation. Even if fairly wide margins have to be allowed in the various factors employed, the use of such factors and the subsequent analysis of the sources of profit and loss resulting from their use give a good deal of useful information.

During the discussion of the paper, it was emphasized that in a valuation, whether of a trust fund or a mutual association, the effect on the cost if the colliery company were to go into liquidation should be borne in mind. This can be met by a certain margin being allowed for on the rate of weekly payment which is actually being made. It will also be remembered that the Cassel Committee (par. 108) was of opinion that 'the claims payable by an Association as a going concern are almost certainly less than they would be if it were wound up'.

In the paper I did not deal with those cases which at the date of valuation are still in their 'first 26 weeks' but which will later extend into the period of 'after 26 weeks'. In the case of our own Associations, if I included this contingent cost I should also have to allow for the potential premium payable on the case reaching the 6-months' period which, owing to loading, etc., might introduce a 'negative value'. On the general question of normal valuation methods, however, I agree that provision should be made for this cost. At any particular valuation date there may be, for example, a case of, say, 20 weeks' duration. This may be (*a*) a continuous case, i.e. in 6 weeks' time it would become a 26 weeks' case, or (*b*) an intermittent case which may not exceed 26 weeks for some years or may never do so. The cost of the possible payment of this further 6 weeks' compensation, whether payable immediately or some years hence, is dealt with in the paper but the more important item is the possible 'after 26 weeks' incapacity' of what

is at present an under 26 weeks' case. In actual practice (owing to the valuation being made some months after the nominal valuation date) the under 26 weeks' continuous cases can be traced through and with a small time adjustment can be valued either as ordinary or suspended 26 weeks' cases, if at the time of valuation they are known to have exceeded the first 26 weeks. The under 26 weeks' intermittent cases can be treated as part of the latent liability. This is one of the contingencies for which I added $2\frac{1}{2}\%$ to the annuity value at the end of the five years which, being discounted at each intermediate duration, gives an addition for the very few extra cases which at a later date exceed 26 weeks by reason of recurrence. I am now using in my valuations an addition of 5 % in place of the $2\frac{1}{2}\%$ given in the example in my paper. The contingency of such recurrences after the first 5 years is covered by the suggested increased percentages of the tabular value, viz. 80 %, 85 %, etc., and a similar latent liability for durations of over 6 months and under 5 years is referred to in the paper.