WORKMEN'S COMPENSATION RESERVES.

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The subject of the reserves necessary to establish workmen's compensation insurance in the United States upon a solvent basis is one which will doubtless occupy a large share of the attention of this Society during the immediate future. No satisfactory precedents or established methods of computing such reserves are as yet available and numerous contributions to the subject, from varying points of view, will be necessary before it can be treated as disposed of. No solution of the problem finally satisfactory from an actuarial standpoint will be possible until the analyzed statistics of some years' experience with workmen's compensation in the United States are available. Meanwhile the practical question is to find a method of computing reserves which will be workable as an insurance department requirement and uniformly applicable, so far as may be, to companies operating in many states and under varying workmen's compensation laws.

The two principal kinds of reserves to be considered in connection with any branch of insurance are (1) the loss reserve and (2) the premium reserve. The loss reserve may be defined as that sum which, with incidental accretions from interest, is sufficient to mature every outstanding obligation, known or unknown, on account of all accidents or other events which may lead to an insurance loss which have happened *prior* to the date as of which the reserve is being computed. In distinction therefrom, the premium reserve has for its primary function the liquidation of all losses which may be payable on account of accidents that may happen or events leading to an insurance loss that may occur *subsequent* to the date as of which the reserve is being computed but prior to the expiration of the policy period for which the premium has been charged or paid. Further reference to the premium reserve will not be made in this paper, since in the case of compensation insurance it does not differ in any respect from that for other branches of casualty insurance or for fire insurance. It may be remarked, however, that the premium reserve for workmen's compensation in-

surance should be required on the basis of the unexpired term of the policy calculated by months instead of by years as at present prescribed in the annual statement blank. The difference in results between the two methods of computation is in many cases sufficiently great to seriously impair the value of statistics based upon the less accurate method.

The two fundamental attributes to be sought in a loss reserve are: (1) it must be adequate; (2) it must not be excessive. As to the importance of adequacy, it would seem superfluous to argue, except for the acknowledged failure of existing liability loss reserve statutes to satisfy this most elementary of tests. In most affairs of life to be forewarned is to be forearmed, but in this particular matter the sources of error are so subtle and reveal themselves only after so careful a search beneath the surface that there is an ever-present danger that the unhappy history of liability loss reserves may be repeated. Under some compensation laws obligations are being assumed which will involve payments to injured employees or their dependents for periods extending over the entire lifetime of certain individuals. The annuity funds thus brought into being are in nowise less affected with the element of trusteeship than are the funds of a life insurance company. Indeed, in the case of compensation benefits, the element of trusteeship is more marked, since the income thus provided more often constitutes the sole means of support of the annuitant or beneficiary. These annuity funds, however, are not preferred liabilities of the insurance carrier and they must consequently suffer in their proportion from weakness at any point in the balance sheet. We should not, therefore, confine our conservatism to the computation of the present values of these annuities, but should extend it to the other portions of the loss reserve and, indeed, to the valuation of the assets and liabilities in general. But the duty of determining a method of computing a loss reserve which will be adequate remains to an especial degree a responsible one.

While this reserve, then, must first of all be adequate, it is also true that it should not be excessive. In the interest of conservatism it is always better to give the benefit of a reasonable doubt to a method which produces the higher reserve, but it is nevertheless important that the reserve should reflect with considerable fidelity the true probability of loss payments. Redundancy should not exceed a reasonable limit. If it does, the apparent

cost of workmen's compensation will be exaggerated, the true profit or loss upon the business will be obscured, and mutual companies, state funds and the newer stock companies may be unfairly handicapped in their competition with old and well-established stock companies possessing an ample surplus from which they can temporarily borrow to set up reserves. To summarize, therefore, these introductory observations: The loss reserve should be (1) adequate; and (2) not excessive.

Before discussing in detail methods of valuing the various classes of compensation benefits it will be necessary to consider the practicability of making an analysis or grouping of every individual notice or claim received, including those relating to accidents occurring during a relatively short period prior to the valuation date. I have come to the conclusion that such a procedure will be found practically impossible where a large volume of transactions is involved. In the case of temporary disabilities, for example, to ascertain promptly whether or not the disability had ceased or was continuing on the valuation date, the wages in each case, whether or not an award had been or would be granted, etc., would involve an amount of labor and expense incommensurate with the value of the results obtained. With respect to the more serious cases, such as deaths, dismemberments, or permanent total disabilities, it would undoubtedly be possible to do more, but even here it is generally some little time after the accident before sufficient information for valuation, such as the number and ages of dependents, etc., is available. Further, bills for medical services incurred would in large measure not yet have been presented. In general, claim records are not conveniently accessible for actuarial purposes until some little time after the date of the accident. Now, it is very important that an insurance company should be in a position to promptly close its annual statement at the end of a calendar year. This would be impossible if any system of reserves were demanded which actually or virtually required an individual analysis of all the more recent notices and claims. I think that we are driven, whether willingly or not, to the adoption of some method of valuation under which the minor cases will have been finally disposed of and the more serious ones will have had an opportunity to develop their true character before being subjected to individual analysis. As respects recent business, then, the loss reserve must, in default of other methods, be predicated upon the

familiar assumption that the pure premium as computed in advance was mathematically equivalent to the hazard and that, in consequence, the incurred losses on recently issued business are equivalent to the pure premiums earned for the corresponding period. I am not unmindful of the objections which may be urged against this method, particularly at a time when premium rates themselves are not being suffered to stand unchallenged. The obvious criticism is that it starts out by assuming, as it were, that which is to be proved. I am not sure, however, that this objection is so serious as it looks. Even though the reserve were based upon an actual analysis of every accident, it would still have to be calculated upon tables of experience which might or might not correspond with the facts in the cases to be valued. In either alternative, the reserve is based upon assumptions. It cannot in the nature of things be based upon anything else. Only completed experience can disclose the real facts. Has either method, then, greatly superior theoretical claims over the other? Not, I think, when applied to recent business. When applied to business so old, however, that the minor cases have been settled and the more serious ones have tended to develop their true character, there is no doubt that a valuation of each individual claim upon properly chosen standards is requisite. Otherwise the results will be vitiated by the accumulative effect of any redundancy or deficiency which might exist in the pure premiums.

The general conclusion is, therefore, that for recent business we should base the loss reserve upon pure premiums and for other business upon an actuarial valuation of each claim. Mr. A. W. Whitney has called my attention to the analogy beween these two methods and the so-called "retrospective" and "prospective" methods of computing the reserves upon life insurance policies, and throughout the remainder of this paper I shall therefore refer to the method based upon pure premiums as the "retrospective" method; while the method of individual valuation of each claim I shall refer to as the "prospective" method.

There is special justification for the use of the retrospective method in all cases where under the provisions of law the premium rates are subject to supervision and approval on the basis of being adequate to carry the risk. Theoretically, where rates are not approved as to their adequacy there is objection to their being used as a basis for reserve computations, but it seems in general im-

practicable to require that business should be specially rerated for purposes of valuation alone; and where the loss reserve is on the retrospective basis as respects recent business only, it does not seem that this objection is of great consequence.

Another objection which might, of course, be urged against the adoption of the retrospective method for any part of the reserve is that if a small company should have the misfortune to experience a catastrophe involving a large number of fatalities, the effect thereof on the company's financial condition would not, in the absence of some special provision for catastrophes, be immediately reflected in the returns. This objection, however, if considered serious, could be overcome by a provision that in the event of the aggregate present value of the death claims incurred by the company during the retrospective period being in excess of a specified percentage, say, thirty-three and one-third, of the earned pure premiums, such excess should be added to the reserve.

The next question for consideration is: over how long a period should the retrospective method apply and should it be made applicable to policy years or to calendar years? Taking up the second part of this question first, it may be noted that there appears to be a pretty general agreement of opinion that a policy year method of accounting is the preferable one. By a policy year method I mean one under which the business is grouped by policies issued during a given calendar year as distinguished from a strictly calendar year method under which the losses incurred during a given calendar year are set off against the earned premium or earned payroll for the calendar year regardless of the date of issue of the policies. Since policies of workmen's compensation insurance are rarely, if ever, issued for a term exceeding one year, I think that what is really meant by a grouping of policies by "years of issue" is a grouping by "policy years or periods commencing in a given calendar year." Where we have to do strictly with completed policy years or periods, the method seems properly described as a policy year method. Now, for the purposes of a loss reserve statute it does not seem of vital importance which of these two methods is adopted. Indeed, the calendar year method has much to recommend it in that its results are more readily comparable with the figures in the company's balance sheet and income and disbursement accounts. On the other hand, if the details of the loss payments and reserve are required to be stated

from year to year according to years of issue, we shall eventually obtain an experience which, after proper allowance has been made for the effect of interest, which is important, will readily disclose the true relation of the premiums and reserves to the actual losses. The business can be traced section by section to its termination and the ultimate cost of the commitments of a given calendar year ascertained. Finally, it is advisable that the system of grouping business for reserve purposes should agree with the system adopted as a basis for the compilation of experience statistics, and for this purpose the claims of the policy year method are undoubtedly superior.

As to the period for which the retrospective method is to apply, it is my opinion that a full calendar year should be permitted to elapse after the date of accident before the claim is valued by the prospective method. Assuming this to be desirable, it follows that the business of the two calendar years preceding the date of the statement should be valued by the retrospective method. Under this arrangement the most recent accident to which the retrospective method applies will be one year from the date of the statement and the most remote accident will be two years from the date of the statement. The average time elapsed between the date of accident and the date on which a prospective valuation commences will be eighteen months, and the total number of cases to be considered individually will be less than five per cent. of the total number reported.

On policies issued or renewed, then, during the two calendar years immediately preceding the date as of which the loss reserve is being computed I suggest that not less than 66⅔ per cent. of the earned premiums on such policies or renewals, less payments actually made thereunder for losses, be required to be set aside as the loss reserve. The suggested percentage of 66⅔ is arrived at from the consideration that the premiums approved by the Superintendent of Insurance of the State of New York as minimum adequate premiums for workmen's compensation insurance are based upon the assumption that 66⅔ per cent. thereof is applicable to losses and 33⅓ per cent. to expenses. Any insurance carrier which conducts its business on an expense ratio of less than 33⅓ per cent. should be permitted at its option to charge a correspondingly higher reserve.

Before passing to the detailed consideration of the prospective

section of the reserve the following outline of the various subdivisions of the proposed loss reserve is presented:

SUBDIVISIONS OF LOSS RESERVE.

A. *Retrospective section* (based upon pure premiums).

Prospective Section

B. Death — Actual mortality. / Suspended mortality.

C. Disability — Total — Permanent. / Temporary. — Partial — Temporary. / Permanent.

D. Medical.

E. *Deferred claim expenses* (supplementary to loss reserve proper).

Death Claims: Actual Mortality.

This item is intended to include all those cases where the death of the employee has actually occurred on or before the date as of which the valuation is made as distinguished from those cases where death adjudged to be the result of the work-injury occurs some time after the injury and subsequent to the valuation date. With reference to these cases three standards of valuation must be decided upon, viz.: (1) a table of mortality; (2) a table of remarriage; (3) a rate of interest. These standards being chosen, the remainder of the work falls strictly within the province of actuarial mathematics. Thus, under the New York law, assuming a widow aged x at the death of the husband and two children aged y and z respectively, the expression for the reserve on December 31 of the nth year following the year of death of the employee, will, for each \$100 annual earnings of the deceased, be as follows:

$$
\begin{aligned}
&30\bar{a}'_{x+n+\frac{1}{2}} + 60\bar{E}''_{x+n+\frac{1}{2}} \\
(1)\qquad &+ 15(\bar{a}_{y+n+\frac{1}{2}:\overline{18-(y+n+\frac{1}{2})}|} + \bar{a}_{z+n+\frac{1}{2}:\overline{18-(z+n+\frac{1}{2})}|}) \\
&- 5(\bar{a}_{x+n+\frac{1}{2}:y+n+\frac{1}{2}:\overline{18-(y+n+\frac{1}{2})}|} + \bar{a}_{x+n+\frac{1}{2}:z+n+\frac{1}{2}:\overline{18-(z+n+\frac{1}{2})}|}),
\end{aligned}
$$

where $\bar{a}'_x$ denotes a continuous annuity terminable either at the death or remarriage of (x), $\bar{E}''_x$ denotes the value of 1 payable at the moment of the remarriage of (x), and the other symbols have their usual significance. Further illustrations of this nature are

not given, since it is not the purpose of this paper to discuss the mathematical complications involved in the valuation of workmen's compensation death benefits. A paper by Mr. W. W. Greene, read at the last meeting of this Society, covers this subject in considerable detail. Some suggestions, however, as to the standards of mortality, remarriage and interest to be assumed may be appropriate.

It is proposed to use the Danish Survivorship-Annuitants' Table of Mortality, an account of which is given on pages 253–274 of Volume X of the *Transactions* of the Actuarial Society of America. This table reflects the mortality experienced by the Danish State Insurance Institution among the lives of female beneficiaries of voluntary reversionary annuity contracts, a class of lives free from the influence of either medical selection or self selection. The experience included over four thousand deaths and covered the period 1842–1900. This table has the great practical advantages that it shows the rate of mortality from age 0 to the limiting age, that it is graduated by the Makeham formula for all ages without a change of constants, and that it is consequently available for valuing joint-life annuities involving the lives of children. For purposes of comparison the annuity values at 3½ per cent. according to this and various other mortality tables are given below:

ANNUITY VALUES—3½ PER CENT. (a_x).

Age (x).	American Experience.	McClintock's Female Annuitants.	French Annuitants.	Danish Survivorship Annuitants.
10	21.225	23.139	22.124	22.533
30	18.605	20.242	19.175	19.950
50	13.535	15.111	14.046	14.997
70	6.482	8.142	7.135	7.753

The use of the Survivorship Annuitants' Table for valuing compensation death benefits was first suggested by Mr. M. M. Dawson, consulting actuary to the New York State Workmen's Compensation Commission, and the table has been adopted by the Commission as a basis for the computation of present values of compensation and the reserves of the State Insurance Fund.

As respects remarriage, it is proposed that the Remarriage Table of the Dutch Royal Insurance Institution, based upon the remarriage experience of that institution covering a period of ten years, be adopted. This table, as well as the Survivorship Annuitants'

Table, is discussed by Mr. Dawson in his recent paper on Mortality and Remarriage Tables appearing in Vol. XV of the *Transactions* of the Actuarial Society of America, page 306. The Dutch Remarriage Table would appear to have a special fitness for the use to which it is proposed that it should be put by reason of the fact that under the provisions of the Dutch compensation law, the awards and payments under which are made by the Royal Insurance Institution, the proportion of the wages paid to the widow and the lump-sum settlement on remarriage are the same as those of the New York law, thus insuring that the underlying economic motives affecting the rate of remarriage are in this important respect similar. Whether or not the remarriage experience in the State of New York will coincide with that in Holland is, of course, a question which the events of the future are alone capable of determining. The table in question, however, is the only experience of this kind which appears in the least degree applicable to compensation conditions in the United States, and it has consequently been adopted by the New York State Workmen's Compensation Commission as a basis for the computation of present values.

For purposes of comparison the rates of remarriage among widows according to several experiences are given below:

RATES OF REMARRIAGE.

Age of Widow.	United Kingdom 1896–1906.	British Patriotic Fund 1854–1900.	Dutch Insurance Institution.
20	.1136	.1395	.1270
30	.1112	.1026	.0665
40	.0413	.0434	.0300
50	.0118	.0103	.0060
60	.0029	.0016	.0015

The desirability, in this connection, of the compilation and analysis of the mortality and remarriage experience under workmen's compensation benefits in the United States, just as soon as a sufficient volume of data has accumulated, is obvious.

The rate of interest assumed should be sufficiently low to take care of investment expenses, possible losses on investments, possible reduction in the rate of interest on the reinvestment of maturing securities and to offset the uncertainties necessarily attendant upon the adoption of a remarriage table based upon foreign experience. The New York Workmen's Compensation Commission has adopted 3½ per cent., which is the highest rate which life insurance com-

panies are in general permitted to use in valuing currently issued business, and it is suggested that this rate will be found suitable for general adoption.

To summarize: the standards proposed for the valuation of claims where the death of the employee has actually occurred are the Survivorship Annuitants' Table of Mortality, the Dutch Remarriage Table and 3½ per cent. interest.

Death Claims: Suspended Mortality.

Where, as in New York, the death benefit is relatively costly as compared with the other benefits provided in the law the question of suspended mortality is of considerable moment and neglect to make proper provision therefor may have a serious effect upon the adequacy of the reserve. In using the term "suspended mortality" I refer to those cases where death adjudged to be the result of the work-injury occurs some time after the injury and subsequent to the date as of which the reserve is being computed. Cases appearing on their face to be permanent or temporary disabilities prove, every so often, to be cases where compensation for death following the disability is payable. Now, from *a priori* considerations, it seems a fair assumption that the probability that deaths occurring among the disabled will be adjudged to arise from the work accident causing the disability will diminish as the period elapsed since the accident increases, and that it will eventually become so small as to be negligible. How many years it will require for this suspended mortality to wear off is a question which, so far as I am informed, there are no statistics to answer. After considering certain data published by the German National Insurance Office, I venture to propose the arbitrary assumptions, however, that suspended mortality wears off at the end of twenty years and that its effect diminishes at the rate of one-half of one per cent. per annum. Under these assumptions the reserve for suspended mortality may be calculated by multiplying the computed reserves for actual mortality by percentages depending upon the number of years elapsed since the year of issue of the policies to which the actual deaths relate as follows:

Years Elapsed Since Year of Issue.	Percentage for Suspended Mortality.	Years Elapsed Since Year of Issue.	Percentage for Suspended Mortality.
2	9.00	12	4.00
3	8.50	13	3.50
4	8.00	14	3.00
5	7.50	15	2.50
6	7.00	16	2.00
7	6.50	17	1.50
8	6.00	18	1.00
9	5.50	19	0.50
10	5.00	20	0.00
11	4.50		

The foregoing is suggested merely as a working rule which might be adopted until statistics which will enable this problem to be analyzed with accuracy become available.

It is possible to investigate mathematical expressions for suspended mortality in the shape of single premiums for an insurance upon a life disabled by a work accident payable in the event of death adjudged to be the result of the work accident for an amount equivalent to the present value of the compensation payable to the dependents existing at the time of death. But while, save for a short period immediately following the accident, the probability of death from all causes increases with the time elapsed since the accident, the probability of the death being adjudged to be due to the accident decreases, and the present value of compensation for death also decreases by reason of the increasing ages and the diminishing numbers of the dependents. In view of all these complications and of the utter lack of any statistical data upon which to proceed, it does not seem to me worth while to attempt at this time to practically apply a mathematical expression for suspended mortality.

The principal objection to the tentative and confessedly arbitrary rule which I have suggested is that it is not fairly applicable to very small or recently organized companies with an exposure insufficient to produce a stable death rate. A company unfortunate enough to have an abnormally large number of deaths would suffer the further aggravation of being heavily charged for suspended mortality, while if a company experienced no deaths at all it would have no reserve for suspended mortality. This objection would not, however, I think, be found in practice to operate frequently. Theoretically there seems no doubt that the reserve for suspended mortality should be based upon a consideration of the

disability cases, since it is these cases which constitute the source of the concealed liability. Where, therefore, the proposed arbitrary rule is used in estimating the suspended mortality, the extra reserve for this purpose should, where a company's business is to be analyzed in small groups, be reapportioned among the groups in proportion to the reserves for disability instead of in proportion to the reserves for actual mortality.

Permanent Total Disability.

Cases of permanent total disability should be valued according to the accepted methods for valuing annuity obligations. Thus, where the compensation law provides for the payment of compensation during the entire period of the continuance of disability, the reserve on December 31 of the nth year following the year of accident is, for each unit of annual compensation,

$$\bar{a}_{x+n+\frac{1}{2}},$$

where x is the age of the employee at the date of accident.

Where the compensation law limits the period during which compensation is payable either directly or through the specification of the maximum amount payable, the corresponding expression becomes

$$\bar{a}_{x+n+\frac{1}{2}:\overline{t-n-\frac{1}{2}}|},$$

where t is the maximum period in years for which compensation may be paid.

It is proposed that the same standards of mortality and interest be employed in valuing permanent total disability benefits as are used for the valuation of death benefits. Aside from its obvious convenience, there are what appear to me to be sound reasons for such procedure. Most of the existing tables showing mortality among lives totally and permanently disabled deal with a group of persons disabled by reason of sickness as well as accidental injury. It seems hardly safe, however, to make any other assumption than that the extra mortality arising from disability due to accidental injury alone will wear off during a brief period after the accident. Although maimed and incapacitated for work at their trade, these lives, after recovery from the shock of the accident, will not ordinarily be suffering from any organic disorder. Experience has amply demonstrated the stimulus to longevity which the assur-

ance of a small income for life confers upon annuitants, and while an annuity value on a life totally and permanently disabled through an accident is doubtless much lower, if computed as of the date of accident, than the value of a corresponding annuity on a healthy life, I think that there is as yet no evidence to prove that after the initial period of heavy mortality has worn off there is any great difference in the annuity values.

A practical matter of great importance is that the cases of permanent total disability should be determined by a careful consideration of the actual nature of the injury and that, in addition to dismemberment cases and those where the disability has been otherwise adjudged total and permanent, there should be grouped among the total permanent cases all those where there is little or no likelihood that the employee will regain his earning capacity. In the event that one or more of these cases should prove to be temporary, the extra reserve thus created would probably have served as an offset to other cases classed as temporary and which turned out to be permanent. It is difficult to see how this matter could be handled without requiring the exercise of some discretion at this point. It will have to be constantly borne in mind that cases of temporary disability of long standing are apt to be cases of permanent disability in disguise, since a seriously injured employee is kept along in the temporary class by a renewal of the award from time to time until the expiration of the maximum period for which temporary disability may be paid, after which he is adjudged to be permanently disabled.

Temporary Total Disability.

The number of cases of temporary total disability which will have to be individually considered under the reserve system proposed in this paper is very small in relation to the total number of such cases. A rational and conservative treatment of these cases, however, will, on account of the great seriousness of each case, be found of the utmost consequence in securing an adequate reserve. In referring to transactions under the (British) Workmen's Compensation Act, 1906, Mr. William Penman, Jr., of the Atlas Assurance Company, states (*J. I. A.*, XLV, 116):

"Now it seems evident that when compensation has been paid for at least two years, there is very little prospect of recovery or of settlement by arrangement, and that the injured workman has

probably in most cases recovered from the shock of his accident and settled down in his altered circumstances. I cannot think, therefore, that there is any very considerable difference between the reserve required for a claim of five years' standing and that for a claim of two years' standing."

There can be no question that an injured employee whose disability has continued for eighteen months from the date of accident will be subject to an enormously smaller rate of recovery than the average employee whose disability has continued for a few weeks. Among the temporary disabilities of long standing there are doubtless many cases where the disability is in fact permanent. It would appear to be a fundamental principle that the present value of a temporary disability approaches nearer and nearer to the present value of a permanent disability as the time elapsed since the accident increases. Available tables of the average durations of temporary disability are of little or no help in this connection, since they cease to give detailed information beyond a certain limited period, usually 26 weeks. In the absence, therefore, of any statistical basis upon which to proceed, I suggest resort to the following hypothesis: If (x) has been disabled for ten years since the accident he is permanently disabled: If (x) has been disabled for eighteen months he will remain disabled for a period which will produce an annuity value equal to 55 per cent. of the present value of a permanent disability benefit. Then on December 31 of the nth year following the year in which the accident occurred, the reserve per unit of annual compensation will be

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

Where the term or total amount of compensation payable is so fixed in the law that in no event can compensation be paid for more than t years from the date of the accident the formula becomes

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

In either of the above forms this formula is so simple as to be very easily applied in practice.

The reserve for temporary disabilities thus ascertained should prove sufficient to carry to their maturity cases of this class and

also to provide against those cases of permanent partial disability, not dismemberment, which may emerge from the cases of temporary total disability of long standing. Among the more serious cases of temporary disability it is especially likely to happen that an employee who, on returning to work, finds that he is unable to secure the same wages as he received before the accident, will receive an award for permanent partial disability based on the adjudged diminution in his earning power.

Partial Disability.

Detailed discussion of the treatment of partial disability cases is unnecessary for the reason that the general principles involved are the same as in cases of total disability, the only additional assumption necessary being that future possible increases in the degree of impairment will be offset by future decreases. So far as we have any information, there seems to be no sufficient reason why this assumption should not be made. Partial permanent disabilities due to dismemberment will, of course, where compensation is provided for a limited term as in the New York law, require a reserve per unit of annual compensation on December 31 of the nth year following the year of accident as follows:

$$\bar{a}_{x+n+\frac{1}{2}:\overline{t-n-\frac{1}{2}}|},$$

where t may be either integral or fractional and is the number of years in the specified term during which compensation is payable.

Medical.

Under the scheme suggested in this paper few, if any, medical or hospital bills will have to be considered, since the most recent accident the consequences of which are to be given individual consideration will have occurred at least one year prior to the statement date. If there are any such, however, they may be easily provided for by specific estimates.

Deferred Claim Expenses.

Compensation benefits are payable at very frequent intervals, usually weekly or bi-weekly, and this service involves a large amount of clerical and other labor—much larger, for example, than is usually necessary in the case of annuity contracts issued by life

insurance companies, under which the payments are less frequent. There will therefore be a large proportion of the claim expense which will not properly be chargeable against current premiums, but must be provided for by an item of liabilities supplementary to the loss reserve proper, which item should not, however, be merged in the loss reserve itself, since we should be in a position to distinguish clearly between the pure losses incurred and the claim expenses incurred. It is difficult to estimate the probable cost of administering these annuity funds, but it would appear that a sum not less than 2½ per cent. of the reserve for losses should be required to be set aside as a reserve for loss expenses.

Liability Loss Reserves.

This paper refers solely to losses under workmen's compensation policies—not to losses under policies covering common law liability or where the question of negligence may be involved. It is assumed in this discussion that the present liability loss reserve statutes will either be revised in the light of existing conditions or will at least be so amended as to provide that they shall not apply to workmen's compensation losses. Where a policy is primarily a workmen's compensation policy but incidentally covers common law liability, it is suggested that it should be treated as a compensation policy and that the liability losses thereunder should be assumed to be covered, on business issued during the two calendar years preceding the date of the statement, by the earned pure premiums reserved, to be followed by a reserve for each individual claim to be not less than what would be charged for the same injury if covered under the compensation law.

Compensation Claims should be Preferred Claims.

The question of making claims for workmen's compensation just as secure, financially, as it is possible to make them is one to which careful thought should be given. It is suggested that it should be provided by statute (1) that in the event of insolvency or liquidation of any insurance carrier workmen's compensation claims are to be treated as preferred over other loss claims and (2) that claims for insurance losses in general, including workmen's compensation losses, are to be treated as preferred over claims against the unearned premium fund. Such action would prove more effective in giving special protection to beneficiaries under work-

men's compensation policies than would the requirement of a special deposit and it would be free from discriminatory results of an objectionable character.

Necessity for Uniformity.

A point to be borne in mind in connection with reserves for compensation benefits is the great complexity of these benefits as compared with those provided in the insurance or annuity contracts ordinarily issued by life insurance companies. This means that the work of developing the necessary valuation formulae is difficult and that the necessary derived tables based upon the assumed rates of mortality, remarriage and interest are extensive. It suggests the great importance of uniformity between states in establishing standards of valuation, since the work involved in employing several different mortality or remarriage tables would be extremely burdensome. Hence it is important that careful consideration should be given to the standards adopted, with the idea that these standards shall continue to be employed uniformly until such time as the experience in the United States permits the compilation of tables showing the rates of mortality, remarriage and the continuance of disability among the beneficiaries of workmen's compensation policies.

Lump Sum Settlements.

While not strictly pertinent in a discussion of reserves, some comment as to procedure where lump sum settlements are required may be of interest. It should be pointed out that standards adopted as bases for the determination of reserves are not necessarily suitable as standards for the computation of the surrender values of benefits under a compensation law. This is particularly true as to present values based upon a rate of remarriage. The rate of remarriage being largely subject to the volitional control of the individual, it is extremely doubtful to what extent these values are admissible for purposes of commutations of compensation on the application of the widow. Even though we could obtain satisfactory evidence not merely that the widow was in good health but that there was no present intent of remarriage, there would still be doubt as to the applicability of present values to particular cases. For example, it would seem from *a priori* considerations that the rate of remarriage among widows with a large

number of minor children will be lower than the rate among widows of the same age with no children, by reason of the indisposition of the ordinary prospective husband to assume heavy economic responsibilities not of his own creating. But to attempt to take account of this fact in the calculations would be at present impossible, owing to lack of data, and even if the data were available the additional actuarial complications introduced would be insurmountable. In general, the element of self-selection makes the use of reserve values for purposes of commutation a dubious procedure.

Increasing Cost of Compensation.

In connection with loss reserves one further point may be mentioned. It is occasionally intimated that these reserves should be made very high to provide for the demonstrated increase in the cost of workmen's compensation insurance following what Mr. F. Spencer Baldwin has aptly characterized as the "psychological response" of the workmen to the law. This fact, however, has no logical connection with the fixing of the loss reserve. That reserve is to take care of accidents which have already occurred, and the fact that these same accidents would cost more if they happened two or three years later, or that more accidents would be reported if the same law had been in effect for several years longer, has nothing to do with the case. It simply means that if rates remain unchanged and loss reserves are accurately computed, the insurance carrier will experience a decreasing underwriting profit as the time since the enactment of the law increases. Any company which wishes to guard against this by setting aside, out of current profits, something to offset the diminished profits of future years should do this by creating a special reserve for that purpose, not by arbitrarily increasing the loss reserve. However, the increasing cost of compensation may indirectly affect the loss reserve, inasmuch as statistics and experience collected during the early years of the operation of an act, if used as a basis for reserve calculations in later years, may prove misleading. It is well to bear this fact in mind in considering standards for valuation.

Conclusion.

Briefly stated, the salient features of the method of computing workmen's compensation loss reserves proposed in this paper are: (1) the basing of the reserve upon pure premiums during an

initial period sufficiently extended to make unnecessary the detailed consideration of that vast majority of claims which are for trivial or minor injuries; (2) the individual valuation of other claims upon the basis of suitable standards of mortality, remarriage and interest; (3) the valuation of the more serious cases of temporary disability upon the assumption that these cases merge into cases of permanent disability after a certain number of years from the date of the accident and that they meanwhile tend to approach permanent disability cases in value as their duration increases; (4) the charging of a reserve for suspended mortality proportionate to the reserve for actual mortality but decreasing as the time elapsed since the year of issue increases; (5) the charging of a supplementary reserve for deferred claim expenses calculated as a percentage addition to the sum of the foregoing items.

Such a plan has no great claim to originality, but I venture to submit that, pending the accumulation of suitable and extensive statistics relating to workmen's compensation in the United States, it will be found labor-saving and practically convenient and may be made to produce reserves which will measure with a reasonable degree of accuracy the probability of loss payments.