

THE ACTUARIAL PROBLEMS OF THE 1920 NATIONAL
REVISION OF WORKMEN'S COMPENSATION INSUR-
ANCE RATES AND THE SOLUTIONS DEVELOPED BY THE
ACTUARIAL COMMITTEE OF THE NATIONAL COUNCIL.

BY

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In accordance with the growing tendency toward greater recognition of the value of actuarial work in casualty insurance, a more important part of the work of the 1920 revision of the workmen's compensation rate manual under the auspices of the National Council on Workmen's Compensation Insurance was assigned to the actuarial profession as represented by the Actuarial Committee of the Council than in any previous revision. While the complete report of that revision will undoubtedly show this and record at least the decisions of the committee on the more important questions presented to it, it seems appropriate that our *Proceedings* should early contain a quite full record of this work, including a resumé of the committee's reasons for its decisions.

The carrying into effect of the committee's decisions was in the hands of a special staff under the direction of Mr. G. F. Michelbacher, Actuary of the National Workmen's Compensation Service Bureau, who was retained by the Council under a special arrangement for this purpose. His paper on "The Technique of Rate Making," appearing in this number of the *Proceedings*, which should be read in connection with this paper to get a true conception of the work of the Actuarial Committee and its relation to the whole revision, gives adequate description of this interesting work, leaving me free to devote this paper exclusively to a discussion of the work of the Actuarial Committee proper, itself an ample field.

The work of the Actuarial Committee during this revision fell naturally into two parts. The first was, on account of its nature, necessarily preliminary to the work of the General Rating Committee and dealt with the problems connected with the compilation of data and its presentation to the General Rating Committee in

suitable form for its work. The second was supplementary to the work of the General Rating Committee and dealt with the problem of converting pure premiums prepared by the General Rating Committee into gross rates for actual application in the writing of insurance. The Actuarial Committee's work was, as usual, advisory in character, the executive decisions of the Council in this respect resting with the General Rating Committee, but its decisions here noted when reported from time to time to the General Rating Committee received in every instance its approval. The two parts into which the work of the Actuarial Committee fell were not wholly independent, for the final result desired must always be kept in mind throughout the course of any such work, even in its most preliminary stages.

OBJECTS TO BE ATTAINED IN REVISING THE MANUAL.

Early in the work of the Council a joint meeting of the Actuarial and General Rating Committees was held, and there was a general agreement that the final desiderata were:

1. Right rates in each state. Rates accurately measuring the compensation insurance cost of its industries under its law and industrial conditions, or in other words conforming to the closest reasonable degree with its own experience.

2. A basic manual in substance as well as in form.

This latter result requires:

- (a) Uniform classifications.

- (b) Some logical relationship between the rates for each state and a basic set of key rates.

The matter of uniform classifications was hardly within the province of the Actuarial Committee, this being generally considered as more properly an underwriting problem. It was however within the province of the Actuarial Committee to develop the nature of the logical relationship between state rates and the basic key rates, and the procedure necessary actually to put that relationship into practice that right rates for the several states as above defined would result. In the final analysis, *this was the actuarial problem* of the 1920 revision of which the detailed problems here discussed were but subordinate elements.

NATURE OF THE RATING PROBLEM.

It has been for some time more or less generally recognized that there are two phases of the problem of establishing workmen's compensation insurance rates for a given jurisdiction. First, it is necessary to establish a proper relativity between the rates for the several manual classifications and, second, to establish a general level upon which all of the rates in the jurisdiction are to be pitched.

The needed level is indicated by the local experience after proper correction has been made for changes in the law, either by specific enactment, judicial decision or administrative procedure between the period for which the experience has been developed, and that to which the new rates will be applied, and for such other developments as can be properly traced.

The relativity between classifications is a function of the scale of benefits in the particular jurisdiction as the law of that jurisdiction (whatever its apparent intent may be) is there actually administered.*

THE DEFECT OF FORMER DIFFERENTIAL METHODS.

The great defect of the flat law differential system heretofore in use† was that it failed to recognize this. Although concealed in the procedure and not, perhaps, always clearly recognized, that system established one fixed and invariable relationship between the rates for the several classifications in the different jurisdictions, based on the law and practice of the state adopted as the basis and gave effect to the variation in statutory provision only in a change of the general level of rates from jurisdiction to jurisdiction. This of itself tends to the necessity of exceptional state rates, for if the relation, say in Massachusetts between the costs for machine shop operation and boat building is as 1 to 2 and the flat differential is used upon Massachusetts costs as a base then everywhere the relation in rates will be as 1 to 2 while the law of New York may be such that the true relative costs are as 1 to 3. Then

* It is often found that the benefits awarded under the compensation acts are quite different from those apparently indicated in the law. For example it has been held in Massachusetts that an injured workman is totally disabled until work can be found for him that he can do. It is not enough that other men in his physical condition have found work and are working.

† See *Proc.*, Vol. I, p. 10; Vol. III, p. 10.

one or both rates in New York must be erroneous and if the classifications are important in New York the local experience will show the error and a correct rate will be made which is not constructed according to the usual rule, being designated as a "New York exception" rate. Before the 1920 revision began actuarial opinion was fairly unanimous that the old single law differential system must soon be abandoned and a new method found.

It is proper at this point to call attention to the fact that, between the time of the manual revision under the auspices of the Augmented Standing Committee in 1917* and the undertaking of this work by the National Council, substantial progress had been made in dealing with the actuarial problems of manual making. Early in 1918, when it was thought the manual might be further revised during that year, the Actuarial Committee of the old informal National Council had given serious consideration to the problems just referred to, and expressed its judgment on several matters. The conclusions of that committee, whose personnel overlapped to some extent the personnel of the National Council committee as now constituted, were tested out and used or modified in two rate revisions in Pennsylvania and one in New Jersey prior to the National Council's undertaking this work, and the Actuarial Committee had the benefit of these discussions and subsequent experiments in which its members had participated for its guidance. Needless to say, they were of great help to the committee.

The proposal to use experience differentials rather than theoretically calculated differentials was first advanced during the work of the Augmented Standing Committee, although not adopted at that time, but further discussion since that time has shown that, while experience is the "acid test," flat experience differentials (*i.e.*, developed by comparison of the relative average total net costs for each state without analysis according to kind of injury or by industry groups) have the same tendency to distort the relationship between classifications as do theoretical flat differentials. The average relation between state rate levels will be maintained which did not necessarily follow when theoretically calculated differentials were used, but the distortion remains if the experience differential is applied uniformly to the pure premiums of the basic state.

* See "Report of Augmented Standing Committee" published by the National Workmen's Compensation Service Bureau.

THE REMEDY PROPOSED.

To avoid this, the suggestion was first presented to the Actuarial Committee of the former National Council that the differentials be calculated by partial or sectional pure premiums, setting up in this way the relative value of the different parts of the several compensation acts according to the type of injury rather than the relative value of the acts as a whole and thus giving due weight to variations in benefits for different types of injury as affecting the relative costs in different industries. Indeed this idea also was presented to the Augmented Standing Committee in 1917, though it was not given much consideration at that time. That this was feasible had been demonstrated by the work in the Pennsylvania and New Jersey revisions above referred to.* It is natural, therefore, to find that the Actuarial Committee presented this proposal to the General Rating Committee at its first joint meeting with that committee when the foundation for the future work was laid. The proposal was accepted. In this way, it was considered possible to provide right rates in the several states and at the same time maintain a basic manual, that is to say to establish a set of key pure premiums for the several classifications and divisions of loss cost which could be developed into correct total pure premiums and gross rates for the classification and state by the application of suitable factors to each of the partial pure premiums, as for death benefits, for permanent disability compensation, for temporary disability compensation, for medical and hospital services.

WHAT DATA SHOULD BE USED?

The first problem presented to the committee was the determination of what data should be used in the preparation of the new manual, first, the states whose experience should be considered and, second, the years of issue in such states. The committee had before it a record of the states for which experience was available and of the policy years available for each such state. It was the view of the committee that the experience of all states available should be combined and used. While it was desirable to broaden the experience to the greatest possible degree, no material damage

* See *Proc.*, Vol. V, p. 256, "Revision of Compensation Insurance Rates 1918," by Messrs. Downey and Kelly, and *Proc.*, Vol. VI, p. 10, "Upon Combining Compensation Experience from Several States," by W. W. Greene; also discussion of these papers.

would have been done from this point of view had the experience of some states been omitted, as the (remaining) volume of data collected from the leading industrial states was so substantial that the addition of experience from several smaller states did not give any great extension to the breadth of basis for ratemaking. On the other hand, however, the manual was to be a national one, and recognition was given the fact that local authorities would have greater confidence in its applicability to their industries and locality if they knew that their own experience had entered into its formation. It was necessary for the committee, having made this decision, so to plan the remaining work that no distortion of relationships between classifications on the level of rates in the several states would result from these combinations. The means taken by the committee to this end are dealt with a little later in this paper.

Prior to the organization of the National Council in its present form, the Actuarial Committee of the former National Council had discussed at considerable length the question of what experience should be used in a manual revision and had reached the conclusion that on account of changing economic and industrial conditions most, if not all, of the data prior to the last two policy years reported upon in Schedule "Z" would be obsolete and to a certain extent misleading in its indications. Accordingly it had recommended that in any general rate revision only the experience of the last two available years of issue be considered. In the present work, the volume of data in the '16 and '17 years of issue being so extensive, the Actuarial Committee accepted this conclusion without having to expend a great deal of time on discussion of this phase of the problem.

THE STANDARD OF REFERENCE, OF BENEFIT SCALE TO BE USED FOR THE BASIC MANUAL.

The second problem before the committee was the standard of reference which should be used to form the basis of the key set of pure premiums. Its decision on this question was to use the experience of the state of New York on the issues of 1917 as a basis. The Actuarial Committee of the old National Council had also discussed this problem at some length and had considered the advisability of a hypothetical composite law which would include the most prominent characteristics of several of the laws, but obviously,

while such a law would have been an advantage as a basis if theoretically calculated differentials were to be used, either for total or partial pure premiums, it was impossible to combine with such a basis a system of experience differentials. That committee felt at that time that experience differentials were much to be preferred and, therefore, the law of an actual state was desirable. Naturally, its preference would be a representative law under which a large volume of business had been transacted. The old Massachusetts law upon which basic pure premiums had been set in earlier revisions* was considered inappropriate, because of the peculiar method of compensating permanent partial disability under the Massachusetts law found in but a very few of the other laws. It was also pointed out that there were advantages in choosing a law which was of relatively high cost rather than one of low cost, as the resultant multipliers in the former case would tend to produce reductions, in passing from it to other states, rather than increases; the psychological effect locally being that much better as a rate higher than that for the basic state creates an initial impression of adverse discrimination that has its subconscious effect even after the misapprehension has been corrected by proof submitted to the public and authorities that no injustice has been done. Giving due consideration to all of these factors, the committee reached the conclusion above noted—that the New York law and the issues of 1917 should furnish the basic standard of reference.

SUBDIVISION OF THE PURE PREMIUM.†

The third important problem before the committee was how the total premium should be broken up for the purpose of passing from key rates on the New York basis to rates for another state having the proper relativity between classifications for that state into partial pure premiums. This was the subject of extended discussion. It was clearly evident that the types of benefits under the several acts with respect to death cases varied so considerably that the pure premium for death benefits should be one of the elements, though later, as a matter of convenience and because of their infrequent occurrence and similarity of cost, permanent total disability costs

* This choice was then dictated by the fact that it was the first state for which a well authenticated volume of data was collected, not from any theory of its desirability as a standard.

† This term throughout refers to net loss per \$100 of payroll covered.

were included with death costs. It was likewise easily agreed that pure premium for medical benefits should also be considered a separate element. It was generally felt that the remainder of the total pure premium ought to be broken into at least two parts, one covering cost of indemnity for permanent partial disability of serious character and the other covering cost of indemnity for temporary disability and permanent partial disability of minor extent. But here a serious practical difficulty was encountered.

The Schedule "Z" returns available to the committee analyzed the loss cost in the several states generally into death, permanent total disability, permanent partial disability, temporary and medical costs, but detailed schedules of the individual cases entering into the total classification costs for permanent partial disability were not available for further analysis. This form of return was used in most states, but the Massachusetts data was reported in accordance with the peculiar provisions of that law, by kind of benefit rather than by nature of injury so that it was not possible to analyze the Massachusetts data with any accuracy by nature of injury further than into three elements, death and permanent total, medical and all other. The Pennsylvania data also were not quite comparable with those of most of the other states. The terms of the Pennsylvania Compensation Act are such that only the major permanent partial disabilities are specifically compensated, and, therefore, the Pennsylvania permanent partial disability data included only such cases. On the other hand, under the New York law, and that of most other states, both major and minor permanent cases are specifically compensated, and the returns under the New York and other Schedules "Z" included as permanent partial disability both types of injuries. Therefore, the Pennsylvania data were not really comparable with other states though apparently so, and, while they might have been brought to a common level by experience differentials the committee was very doubtful whether under the circumstances the data combined in this way would be any more valuable than where the "all other" data were consolidated before conversion. The committee was therefore, confronted with the virtual certainty that, if a further analysis were made the Massachusetts data would have to be excluded and, probably, also the Pennsylvania data. The committee accordingly reached the conclusion that it would be better to make no analysis of this item than to reject the experience of two such important

states, and decided that at this time the pure premiums should only be broken into the three elements, death and permanent total, medical and "all other."

In accordance with the provisions of the Constitution of the National Council and with the general intent respecting its work, the committee's work was conducted in the open and representatives of certain Rating Boards and others interested were present during a part or all of its sessions, especially during discussions of the method of conversion. The representative of one local Bureau did seriously challenge the soundness of the committee's conclusions with regard to the division of the pure premium, and in view of that challenge, the committee reconsidered the matter and went over the whole problem again with great care, going so far as to test, upon the basis of New York, Pennsylvania and New Jersey experience, the effect upon the "all other" converted losses of dividing them into "permanent partial" and "temporary" and separately converting and combining those two elements and then adding the combined results together. As compared with converting by a single factor, the results showed so little variation that the committee was satisfied of the wisdom of its first decision and placed itself on record with its reasons by adopting a resolution embodying the following points:

1. Since it is necessary that the final pure premiums underlying the rates in any state should reflect the actual losses of that state, the final losses for the state must be determined by its own experience.

2. As a necessary corollary to this proposition, the combination of the experience of several states is solely for the purpose of eliminating the accidental fluctuation due to limited data and producing a smoother and more accurate graduation. If the relation between the pure premiums for the several classifications.

3. Past experience has indicated clearly that the old system of flat law differentials does not produce proper results and that much better results are obtained by combining the experience separately for different types of benefits as to which either the frequency of occurrence or, more particularly, the character of benefits in the laws of the several states as they are administered are considerably divergent. It is recognized that a logical carrying out of this proposition calls for a separation of the pure premium for purposes of this combination into death, permanent total, permanent partial, temporary and medical.

4. It was found, in view of the way the data have been collected in some of the more important states, notably Massachusetts, and the difference in the way certain minor permanent disabilities were

compensated under the laws of some states, notably Pennsylvania, it would be very difficult, if not impossible, to utilize the experience of all states on this basis. It would be possible, however, to utilize all of the experience if, in making the combination, permanent partial disability losses and temporary losses were treated as a single element of the pure premium.

5. The committee did not feel justified in taking this action without test and, while the time was not available to make a thoroughly exhaustive test, the committee did make a test which it felt was very rigid, using a combination of the Pennsylvania, New York and New Jersey experience for certain classifications, first separating the permanent partial losses from the temporary losses and combining each separately, and taking the sum of the pure premiums as the pure premium for the combined element and then combining the data for permanent partial and temporary together before working out conversion factors and combining the data from the three states in this way. When the graduations of the total pure premiums for temporary total and permanent partial by the two methods were compared, it was found that the results showed little variation. Further discussion developed that this was a logical result, since possible errors in conversion are minimized in the process of combination.

CONVERSION BY GROUPS CONSIDERED ADVISABLE.

The committee recognized that whatever difficulty might be involved in its treating the "all other" in one item would arise from the fact that permanent partial disabilities are compensated in the different states on a more variable basis than temporary disabilities, and it, therefore, felt that the possible error of the use of a single "all other" conversion factor would be minimized if, instead of making the conversion factor for bringing the data of any state to the common level the same for all classifications, the classifications be divided into groups with some regard for the probable extent of permanent partial disability cases. The first effort was to set up four groups:

1. Classifications involving heavy outdoor work.
2. Manufacturing classifications where there were high dismemberment probabilities.
3. Other manufacturing classifications.
4. General commercial industry.

A study of conversion factors was made as between New York, Massachusetts and New Jersey on the basis of these groups, and it

was found that the results did vary enough for some states to justify resorting to this method. It was found, however, that the differences between the factors produced for the commercial and the light manufacturing were so slight as to warrant combining these two groups, and this was done, reducing the number from four to three. At this point a conference was held with the General Rating Committee and joint sub-committees were appointed to go over the manual and assign each of the several classifications to its appropriate group upon the above basis.

In order to minimize the amount of mechanical work involved in converting and combining experience, the committee considered whether it was necessary to use all classifications or whether a limited number would be sufficient, and after some test reached the conclusion that, if a sufficient number of representative classifications were used, the work could safely be so cut down. Accordingly, it adopted the policy of using twenty classifications in each group for conversion purposes, although in some states the number was restricted to less than twenty because the volume of data on some classifications was so small that distorting variations might be introduced if they were given an influence in this matter.

THE CONVERSION FORMULA.

The next problem before the committee was the formula or method that should be used in making the conversion of the experience to the common level for purposes of combination. Here it had the advantage of the work that had gone before it. When the prospective revision of the manual in 1918 was considered by the National Reference Committee, the Actuarial Committee had carefully considered this problem and had recommended the use of the partial-pure-premium method, with experience differentials for purposes of conversion. The method suggested at that time was the application to the payrolls in one state of the pure premiums in another and the comparison of the actual losses with the expected losses as so projected. As a check upon errors which might be introduced by classifications having a small exposure, it was proposed at that time that the reverse process be also used and that the final result be determined by considering the mean of the indicated results of the two processes. This was tried out for the medical and "all other" sections of the premiums in the 1918 revision in Penn-

sylvania, as has been indicated to this Society in the paper by Dr. Downey and Mr. Kelly dealing with this work.*

In that revision, as is also indicated in that paper, the previous recommendation was departed from to the extent that the "death" and "permanent total disability" experience was combined on the basis of a count of the number of cases and the application of an average cost. This was done because it was found the pure premiums showed such wide and peculiar variations on account of the infrequency of fatal accidents and the variation in their cost that a strict following of the recommendation would have led to confusing results. In the 1919 Pennsylvania revision a further step was taken and the average cost of D. & P. T. D. was graduated by classifications after a study of the cost of the individual cases which arose. This was on account of the fact that certain industries employ predominantly women so that when death cases occur there is much more than the normal proportion of no-dependency cases. Others, while employing chiefly men use a migratory class of laborers who likewise, in the large proportion of cases, have no dependents. A test of this was made on the more extended data available at this time and the conclusion reached that there was enough variation in the average cost of fatal accidents in different industries to call for such an analysis and it was made for each state by dividing the classification into two to six groups depending upon the volume of data available and its indications and using one average value for each group rather than a single value for the whole experience of the state.

It was the first judgment of the Actuarial Committee that for the purpose of rate-making all that should be necessary on the part of the General Rating Committee would be the indication of the number of such death or permanent total cases to be expected in the given classification, per unit of exposure (that is a tabulation of pay roll exposure and number of occurrences only), and that this number could then be converted into pure premiums for each state by the application thereto of an appropriate average value. It was felt, however, that this task would be confusing to the General Rating Committee which in all the other work would be thinking in terms of partial premiums and that they would be able to determine results better if this element also were presented to them in the form of pure premiums, and it was, therefore, decided that, in

* *Proc. C. A. S. A.*, Vol. V, p. 256.

presenting the experience on the New York 1917 basis, the number of cases would be multiplied by the average New York cost (for groups of industries as above noted) and presented to them in the form of pure premiums. It was decided that for other states the basis pure premiums selected as for New York should be made into state pure premiums by applying the factor of relativity between New York average cost per case and local state average for the same group of classifications. It must be fairly apparent that this brings about the same result as though the committee had selected a probability of death occurrence which was to be translated into terms of premium by multiplying by the average cost per case.

For example, let us assume that the average D. & P. T. D. cost in a certain classification was in New York \$4,000 per case and in Massachusetts \$3,000 per case and also that the composite experience showed \$40,000,000 of pay roll exposure and 10 deaths or permanent total cases with a cost in the New York basis (as used) of \$40,000. The committee would have an indicated D. & P. T. D. pure premium of \$0.10 and we may assume would adopt this. Then since the average cost per case in Massachusetts is $\frac{3}{4}$ that in New York its pure premium would be \$0.075. The indicated probability of death per \$100 of payroll exposure is 10 in 400,000 such units or .000025 and if this be converted to New York pure premiums by multiplying by \$4,000 and to Massachusetts pure premiums by multiplying by \$3,000 we again have as the pure premiums \$0.10 and \$0.075 respectively.

Having thus disposed of the conversion formula as affecting "death" and "permanent total disability" cases, the committee passed on to the conversion of "medical" and "all other." Mr. Greene's paper appearing in *Proceedings*, Vol. VI, p. 10, was available to the committee. A test was made of his conversion formula (6)* on page 16 and it was found that the formula was not quite so accurate as Mr. Greene had in the first instance hoped. A study by the committee of the several formulæ resulted in one of the members presenting to the committee a rather full memorandum dealing with the general relationships of the several formulæ which had been used for the purpose, showing that they were all approximations on the basis of different assumptions to the accurate formula

$$* E = \frac{1 - D \frac{\text{Total Losses for Basic State}}{\text{Total Losses for Additional State.}}}{1 + D}$$

$$E = \frac{\Sigma \left(\frac{JM}{J+M} \cdot j \right)}{\Sigma \left(\frac{JM}{J+M} \cdot m \right)}$$

given in the footnote on page 15 of Mr. Greene's paper. (It will be understood that by "accurate" formula is meant the one which so combines the data that when the pure premiums derived from the combination are applied to the payrolls for the basic state the total expected losses as produced exactly equal the actual incurred.) The memorandum also developed a method of applying that formula which was quite as simple as that for the formula Mr. Greene had used. It was, however, pointed out that, since the formula reproduced the losses of the basic state with absolute accuracy, it was dangerous to use in connection with the developing of conversion factors by a selected number of classifications when all classifications were not used, for it is within the range of possibility that there might be one or more classifications selected among the group for conversion purposes whose experience was such that it would distort the true indications and this distortion would not be brought out by the application of an exact formula. On the other hand, an approximate formula which is reasonably accurate when the classifications used for the conversion purpose are fairly homogeneous will show by the amount of error in reproduction whether or not there is such homogeneity. This is an important advantage in practical work as we later found in a few cases. Generally, however, the data originally selected to develop the conversion factors was sufficiently homogeneous and representative, so that review was not necessary.

The memorandum presented is too lengthy to reproduce here in full, but the comparisons are well worth recording in this paper. With a slight change in notation which is probably obvious, Mr. Greene's accurate formula appearing in the footnote above referred to is:

$$*E = C_j^m = \frac{\Sigma \frac{JM}{J+M} \cdot j}{\Sigma \frac{JM}{J+M} \cdot m} \quad (1)$$

* Read C_j^m as conversion factor Massachusetts to New Jersey. Otherwise the notation is as used by Mr. Greene. M and J represent Massa-

By dividing both numerator and denominator of the numerator fractions by M and of the denominator fractions by J , this formula takes the form:

$$C_j^m = \frac{\sum \frac{Jj}{\overline{M} + 1}}{\sum \frac{Mm}{\frac{M}{J} + 1}} = \frac{\sum \frac{L_j}{\overline{M} + 1}}{\sum \frac{L_m}{\frac{M}{J} + 1}}. \quad (1a)$$

This is the form in which it is easiest of application, if it is found desirable to use this form.

The earliest approximation, the one suggested by the actuarial committee in 1918 of the old National Reference Committee, takes the form:

$$C_j^m = \frac{\sum Jj}{\sum Jm} = \frac{\sum L_j}{\sum L_m}, \quad (2)$$

or

$$C_j^m = \frac{\sum Mj}{\sum Mm} = \frac{\sum Mj}{\sum L_m}.$$

When applied in the two separate ways and when the mean of the two results is taken as the true indication, the form is:

$$C_j^m = \frac{1}{2} \left(\frac{\sum Jj}{\sum Jm} + \frac{\sum Mj}{\sum Mm} \right). \quad (2a)$$

A comparison of this with the accurate formula indicates that the assumption underlying this approximation is that for each classification the proportion of payroll for the two states has a constant ratio (i.e., $M/(J+M)$ or $J/(J+M)$) is the same for all classifications so that it may be taken outside the sign of summation and cancelled from numerator and denominator). This formula, therefore, is quite inaccurate, since this assumption is very far from being realized in practice and since the work rests entirely upon the least dependable or most variable element involved, the local pure premium. This is also the most laborious of the several approximate formulæ.

Massachusetts and New Jersey payrolls respectively, m and j the local pure premiums and L_m and L_j the respective incurred losses.

Probably the next formula in order of development was:

$$C_j^m = \frac{\Sigma j}{\Sigma m}. \tag{3}$$

This is the comparison of the unweighted arithmetic mean of the local pure premiums. This assumes that the ratio $JM/(J + M)$ is a constant. Here again the work rests upon the most undependable element, viz., the local pure premiums, and it is obvious that the assumption is not realized in practice with any greater closeness than the assumption underlying the earlier approximate formula. It will be apparent from the form of the formula that it is, however, relatively easy of application if all the local pure premiums are worked out. But if not then it is very laborious since these must be worked out for the purpose.

The next approximation considered was the ratio of the average pure premiums for each state. Mathematically expressed it is as follows:

$$C_j^m = \frac{\Sigma L_j / \Sigma J}{\Sigma L_m / \Sigma M}. \tag{4}$$

This is the comparison of the two average pure premiums on total experience used for each state.

Dividing the denominator of both numerator and denominator fractions by $(\Sigma J + \Sigma M)$ and writing for L_j and L_m their equivalents Jj and Mm we get as the form.

$$\begin{aligned} C_j^m &= \frac{\Sigma Jj / \frac{\Sigma J}{\Sigma J + \Sigma M}}{\Sigma Mm / \frac{\Sigma M}{\Sigma J + \Sigma M}} \\ &= \frac{\Sigma Jj \cdot \left(\frac{\Sigma M}{\Sigma J + \Sigma M} \right)}{\Sigma Mm \cdot \left(\frac{\Sigma J}{\Sigma J + \Sigma M} \right)}. \end{aligned} \tag{4a}$$

This last expression shows the relation of this formula to the accurate formula. The assumption here is that we may use, where the payroll enters the formula, the mean of the payroll for the several classifications in each state in lieu of the precise payroll. The

result of this is to give within each state uniform weight to the losses in each classification, whereas in the preceding formula uniform weight is given to the pure premiums in each classification. Therefore, this formula will be more stable in practice than the preceding one. Since, as noted, the conversion factor here is merely the ratio of the two average pure premiums and is derived by adding the losses in each of the states and the payrolls in each state, forming the state average pure premium in each case and taking the quotient it is very simple of application.

The latest approximation is that developed by Mr. Greene and takes the following form:

$$C_j^m = 1 - \frac{D \frac{\Sigma L_j}{\Sigma L_m}}{1 + D} \quad \text{where} \quad (1 + D) = \frac{\Sigma \left(J \frac{L_j + L_m}{j + M} \right)}{\Sigma L_j}. \quad (5)$$

The relation to the accurate formula is not so simple nor so easily shown as in the other approximate formulæ, and it is not necessary to reproduce it here since it is fully explained in Mr. Greene's paper already cited.

Prior to the presentation of these comparisons, the committee had made several trials with Mr. Greene's formula and had tested out its accuracy. It observed that the work of testing-out this or any approximate formula was in itself the preliminary step for a second application of this formula (i.e., it was the calculation of $1 + D$). It also noted that where on first application the losses in the basic state were not reproduced the second application produced a result that was accurate within as narrow limits as could possibly be desired. The double application of Mr. Greene's formula, however, involves a large amount of work, and, realizing that there was no restriction upon the accuracy of "R" in his formula

$$E = \frac{R - D \frac{\Sigma(Bb)}{\Sigma(Aa)}}{1 + D}$$

the committee determined to try the use of this formula as a secondary or closer approximation upon one of the others as a first approximate and it found, by test, that formula (4) in the above

study and comparison, namely, the ratio of the group pure premiums, was not only easiest of application but most accurate in itself.

The committee, therefore, resolved to make the conversion by the successive use of these two approximate formulæ, provided that the test-out of the results of applying the first (which, as I have already pointed out, constituted the first step in the application of Mr. Greene's formula) indicated that the factor so produced required correction. The assumption involved in the first approximation put enough strain on the formula to develop, by an inaccuracy in reproducing the basic losses, the presence of a disturbing classification and enabled the committee to go over again, where necessary, the classifications chosen for conversion purposes, and the two formulæ in successive application gave a highly accurate result. In actual application this method of working proved very satisfactory. Mr. Michelbacher, in his paper, reproduces the working sheets that were used, so that it is not necessary to exhibit them here, and reference is made to his paper for that purpose. These formulæ were used for the purpose of conversion and combination with respect to the "medical" and "all other" elements.

It will be noted that the experience of two years of account was used for each state, and a strict following through of the theory of the committee would call for the separate conversion to the New York level of the experience of each year of account. This, however, would greatly add to the labor of compiling the statistics, and, unless there was an important amendment to the Compensation Act between the central dates of the issues of 1916 and the issues of 1917, or some very substantial change in industrial conditions between the period covered by the two years of account, there would not be a serious difference in the relativity between the several classifications for the partial pure premiums in the two years. Under such circumstances, substantially as good results could be obtained in conversion by adding together the experience of the two years of account and then making the conversion at one time. This being so much simpler and easier in application, the committee decided upon this procedure.

With the determination of this question, the preliminary work of the committee was completed and the committee was ready to pass on to the second group of problems for its consideration, viz., the projection of pure premiums selected by the General Rating

Committee on the basis of New York 1917 issues of experience to state gross rates.

As soon as the partial pure premiums, as reviewed by the General Rating Committee, became available it was necessary to have developed the procedure by which those pure premiums on the level of issues of 1917 for New York were to be converted into gross rates for the several states, in order that the work of developing the gross rates might proceed with expedition. The Actuarial Committee, therefore, continued its work and undertook this second phase of its problems—the determination from the basic pure premiums of state gross rates, which involved two steps:

1. The determination of state pure premiums at approximately current level and
2. The determination of the loading necessary to cover taxes and expenses, including service and other expenses.

The determination of state pure premiums at approximately the current level is again divisible into two separate items, (a) the translation or reconversion of the basic pure premiums into state pure premiums at the level of past experience and (b) the projection of graduated state pure premiums of the experience period to the level of cost of the present date.

TRANSLATION FROM BASIC PURE PREMIUMS TO STATE PURE PREMIUMS.

The first step in this process has been foreshadowed in the description of the process of converting the experience to a common level, particularly in the statement of the committee quoted above relative to the subdivision of the pure premiums for purposes of combination. This first step would naturally be the reconversion of the pure premiums from those selected by the general rating committee on the basis of 1917 issues, under the New York Act, to the basis of the 1916–1917 issues for the particular state for which the gross rate is to be made. The conversion process is, necessarily, of the same nature as the conversion process when the experience of the state in question was brought to the level of the New York Act, although in this case the states are reversed, and now the New York experience is brought to the level of the state in question.

It was the committee's first judgment that for the purpose of this conversion the experience of the local state for the year of issue

1917 only should be used, but, on consideration of the matter, it was felt that a better result would be obtained if, instead of merely the one year the experience of two years of issue were used.

The committee made this decision because the method later described in this record was found for projecting from the 1917 issue level to the 1919 issue level and it was realized after a little reflection that that method was not restricted to the case of passing from the level of the actual year of issue in one state to the later level, but was equally applicable for passing from any experience period for which payrolls and losses are available to the later issues. It was therefore not necessary to pass to the issues of 1917 for the local state but was sufficient to pass to the combined issues of 1916 and 1917 and this could be done by using the reciprocal of the original conversion factors since the same two sets of conditions were being compared though in the reverse ways.* Thus the large labor of computing several new sets of conversion factors was avoided. It was not, however, possible further to reduce the labor and apply the projection method direct to the selected pure premiums (New York basis) as this method determines level only and it is necessary to reconvert to the local state basis to give effect to the relativity between classifications determined by its own conditions.

At this point it should be stated that it was recommended to the General Rating Committee, and approved by them, that, after the selection of the pure premiums upon the standard basis, and their translation to the level of another state, the result be reviewed in comparison with the local experience and special consideration be given those classifications where the local experience was sufficiently broad to be really indicative, with the intention of making rates by way of exception on the basis of local experience wherever that experience seemed to warrant and the rate produced by the usual process was considered out of line with the indications of the local experience. Cases where this was necessary were relatively few.

* It was stated that the conversion factors reproduced with high accuracy in the expected losses of the basic State the aggregate actual losses regraduated by classifications. In reversing the process by applying the reciprocals rather than recomputing new factors from basic pure premiums to state pure premiums a slight discrepancy was sometimes found due to the fact that by the inclusion of the data if many states the weights of the various classifications in the experience of the basic states were changed. The discrepancies found were slight and the committee felt since it was due to the use of reciprocals of the original factors as approximations to the true factors correction could properly be made by a flat factor.

STATE PURE PREMIUMS BASED ON STATE EXPERIENCE REGARD-
 UATED BY COMPARISON WITH NATIONAL EXPERIENCE.

The net result of the conversion and combination of the experience data in accordance with the rulings laid down by the actuarial committee, the review of the total experience by the General Rating Committee and its reconversion and check with the original local data produces at this point for each state a series of pure premiums upon the level indicated by the experience with the combined 1916 and 1917 issues within that state, graduated in their relation among the several classifications by comparison with and recheck against the experience of the country as a whole, but giving essential weight to the local experience in the classifications where the greatest amount of exposure was produced locally, i.e., to the classifications of greatest local importance.

So far we have conformed to the desiderata set out at the opening of this paper, viz., a basis for right rates in each state and a basic manual in substance as well as form, the latter being represented by uniform classifications and a logical relationship between the rates for each state and a basic set of key rates. But we have not yet passed beyond the period which developed the experience.

The remaining problem then is that of passing from the pure premiums on the level of the combined issues of 1916 and 1917 to pure premiums of essentially the present date.

PROJECTION TO PRESENT CONDITIONS.

A comparatively brief review of industrial conditions of the time covered by the policy issues of 1916 and 1917 with a like survey of the present industrial conditions will very readily indicate that they are not precisely the same. In former rate revisions we have faced similar difficulties. Indeed, as the work has heretofore been conducted there has always been a lag between the development of experience and the making of rates, a lag inherent in the methods heretofore in use in compiling experience and other statistical data. (Parenthetically it may be remarked the National Council has been asked to study and develop new methods to avoid this lag.) In former rate revisions prognostications for the future were made on the basis of observed tendencies here and abroad in the history of compensation insurance.* These were admittedly on a hypo-

* For example factors were introduced to reflect increasing cost with age

thetical basis and rested primarily upon what has been before referred to in this Society as "subjective judgment." These judgments were sometimes correct enough on the phases of the rate problem considered, but, unfortunately, other phases were generally overlooked and sometimes as with the recent advance in wages their tendency was in the opposite direction to those allowed for. In any event, the judgments themselves have from time to time been subjected to rather drastic criticism. Although the matter was not made the subject of a definite resolution by either the Actuarial or the General Rating Committee, it was very generally understood that in the present rate revision such subjective judgment factors would not be used. Tendencies indicated by the experience and statistics of American compensation insurance would be considered on the basis of the indications but conjectural factors based on general reasoning by European analogy would not be introduced.

CHANGE IN WAGE LEVELS.

It was recognized that among the conditions which had materially changed since the issues of 1917 was the level of wages in all industries, and the Actuarial Committee was requested by the General Rating Committee to undertake to measure this. Accordingly, a call was sent out to all companies asking for information as to wages of employees injured during the last half of the calendar year 1917 and the last half of the calendar year 1919, and upon the basis of these returns standard distributions of wages were constructed for several geographical regions of unlike conditions. The returns were called for by groups of classifications, in three groups corresponding to what were believed to be the high-paid, low-paid and intermediate industries. While the levels of wages in the three groups were different, the distributions were such that when the limits of the Compensation Act in New York in 1917, and as amended by the 1920 session of the Legislature, were considered, it was immaterial in practice whether one or another of the three groups or the composite of all the groups was used.

of act as had been found abroad, increasing accident frequency with increased industrial activity, etc. See Report Augmented Standing Committee already cited.

INCREASE IN THE MEDICAL SERVICE COSTS.

It was also recognized that, along with the general increase in wages and living cost, the medical profession had been compelled to increase its charges and that this had resulted in a substantial increase in the costs of these benefits to the carriers. The committee, therefore, undertook an investigation to determine the extent of this, by calling upon the several carriers to report to it their number of accidents requiring medical treatment occurring during the last half of 1917 and the last half of 1919 and their expenditures for medical, hospital and like services for the same periods. On the basis of this information, average costs per case for each period were worked out, and it was found that in New York, for example, the cost had increased approximately 50 per cent. There was a substantial increase in all states but as with the wages it was not uniform for the entire country.

OTHER CONDITIONS PRODUCED CHANGED COST.

It was also known that in New York, at least, there had been a material change in other conditions. This was due, in part, to a decision of the New York Courts construing one provision of the Compensation Act in a quite different manner from that which had been followed in making awards prior to that time. In addition to this, a governmental special investigation of the conduct of the Industrial Commission had brought about a considerable change in their manner of handling cases and their attitude toward carriers and claimants. Obviously, these must affect the costs of covering the compensation liability and should be taken into account in developing the rates.

THE PROJECTION TO CURRENT LEVEL.

The committee, therefore, was confronted with the problem of working out a reasonable allowance for these items upon a basis of fact as represented in experience and without the use of more than a modicum of individual judgment. After a considerable study, the committee proposed that this problem be solved in the following manner for all states,* namely that:

1. A loss ratio be worked out for the issues of 1919 for each state.

* The committee's first investigation was based on New York data for the solution of the rather unique New York problem but as it developed and tested the method it was found of general applicability and provided on a statistical basis a solution for the problems which in other revisions gave rise to conjectural factors.

2. The 1916 and 1917 payrolls for a representative group of classifications in such state be multiplied by the manual rate at which the 1919 policies were issued, and the hypothetical premium income so developed be modified by such factor as may be found on experience to represent the actual effect of schedule and experience rating on the 1919 issues in such state.
3. By comparison of this with the combined actual losses on these classifications of the issues of 1916 and 1917 entering into ratemaking experience, a loss ratio be found.
4. A comparison of these two loss ratios* be made which will be the measure of relativity between the pure premiums for combined 1916 and 1917 issues and the pure premiums for 1919 issues. This will be so because, while the comparison is between loss ratios, it is between loss ratios developed from a common premium level basis and, unless violently distorted by change in distribution of the business between the two years, will be the equivalent of a comparison between pure premiums themselves.

The standard form of Schedule W calls for the following data, as of December 31, 1919, by year of issue for each of the four or five preceding years: Earned Premiums; Losses Paid; Losses Incurred; Loss Ratio; and the Schedule is so drawn as to show these as originally reported at the end of the calendar year in which the policies were written, and at each subsequent December 31.†

Policies Issued.	Calendar Year.				
	1916.	1917.	1918.	1919.	Total.
in 1916					
Earned Premiums.....					
Losses Paid.....					
Losses Incurred.....					
in 1917					
Earned Premiums.....					
Losses Paid.....					
Losses Incurred.....					
in 1918					
same data.....					
in 1919					
same data.....					
Totals.....					

* The actual loss ratio on 1919 issues above referred to and the hypothetical loss ratio developed by comparing the actual losses on combined 1916 and 1917 issues with the premium income which the payroll exposures would have developed at the 1919 going rates.

† The Schedule calls for a tabulation relative to the losses in the jurisdic-

The preliminary investigations of the committee based on New York Schedule W returns indicated that the Losses Paid at the end of the calendar year in which the policies were issued bore a remarkably stable percentage relationship to the ultimate incurred losses on that same year of issue.*

The committee was not satisfied to rest there, but searched further and made the comparison on a countrywide basis, from the returns in Schedule P of the Annual Statement as it is now prepared and Schedule O of the Statement as it was a few years ago. These ratios of Losses Paid at the end of the calendar year in which the policies were issued to the Ultimate Incurred Losses under such policies, showed a similar stability.

The Schedule W returns also show the Losses Paid on the issues of 1919 during the calendar year 1919, and we were thus able to project the Ultimate Incurred Losses upon these policies by dividing the Losses paid at the end of the calendar year by the percentage factor which, upon the average, they have been found to bear to the Ultimate Incurred Losses. Thus, we got a fairly dependable estimate of the Ultimate Incurred Losses on 1919 issues the numerator of the fraction which measures the loss ratio on the issues of 1919.

The committee recognized that, if a similar factor could be found to apply to the earned premiums of a given year of issue at the end of that calendar year, the denominator of the loss ratio fraction would be found, and the loss ratio on the 1919 year of issue thereby developed. There seemed to be a considerable degree of stability in the ratio between the earned premiums of a given year of issue at the end of that calendar year and the ultimate premiums on that year of issue; but this figure was confused somewhat by varying methods between companies in computing proportionate earned premiums and by varying practices as respects interim audits. It therefore seemed that if the data could be obtained, better results might be had by comparing the Net Premiums Written as recorded at the end of the year in which the policies were issued with the ultimate premiums made up substantially as follows though some items not used by the committee are omitted in this reproduction.

* In the state of New York these percentages for a representative group of companies were on '16 Issues 13.9 per cent., on '17 Issues 14.2 per cent., on '18 Issues 13.7 per cent., Average of 3 years 13.8 per cent., and similar stability has been shown by the figures for other states on a much smaller volume of data after allowance has been calculated for the effect of intervening amendments.

the ultimate premiums of the same year of issue, although these net premiums written were not shown in Schedule W.

From a study of Schedule P, in which the premiums were entered in this way, this conclusion seemed to be verified. The committee, therefore, selected a group of representative companies, having a substantial volume of business in New York, obtained by correspondence with the companies their net premiums written for the several years of 1916, 1917, 1918 and 1919, as recorded on their books at the end of the calendar year of issue, and compared the net premiums written with the ultimate earned premiums on the same year of issue, for years 1916, 1917 and 1918.

A similar study was made from Schedule P dealing with the same group of companies. While these figures do not show quite the stability of the losses paid to ultimate incurred losses, the committee felt the general trend, both as shown by the New York data and the countrywide data developed from Schedule P, was sufficiently dependable to project approximately the ultimate premium income on the 1919 New York issues and to develop the loss ratio required for this test.

This conclusion was reported to the General Rating Committee and, after extended debate and comparison of the loss ratio on 1919 issues developed in this way the loss ratio on the uncompleted year, as reported in Schedule W 1919, and the loss ratios of earlier years, as reported in successive returns of Schedule W, the general method received the approval of the General Rating Committee not only for New York, but for other states where as it was tried similar stable ratios were found to enable 1919 issue loss ratios to be projected with considerable confidence.*

This investigation of the committee introduced something new into the ratemaking procedure hitherto in force, and laid the foundation for developing the experience of the past toward present conditions upon a statistical basis as contrasted with the unstable basis heretofore used in the rating conferences for this work. The committee was not able to project beyond the conditions of the issues of 1919, but it did feel that this method of projection was satisfactory, notwithstanding that on the average the issues of 1919 will not expire for several months yet.

* In some of the states the problem was complicated by changes in manual rates having been made during 1919 or an amendment taking effect in that year but satisfactory bases were found for making adjustments to allow for these.

This method of projection, however, gave a composite factor, and, while it did involve all of the various elements tending to change the costs, it could only be applied to partial pure premiums as a flat factor.

The committee then gave consideration to the possibility of breaking up this total projection factor. After study by a sub-committee and consideration of its conclusions by the entire Actuarial Committee, a general conclusion was reached, as set forth in the following resolution:

Resolved, That the Actuarial Committee advise the General Rating Committee with reference to the projection factors as follows:

That as respects the subdivision of the total projection factor the committee reports:

(a) That it believes this question should be taken up separately for each state after the total projection factor for the state has been determined.*

(b) That as regards New York the total factor should be subdivided as follows:

D. & P. T. D.	1.00
Medical	1.07
All Other	Balance†

In support of the recommendation with reference to the subdivision of the total projection factor for New York, the committee made the following note:

1. The medical factor of 1.07 is determined by comparing the increase in the average cost of medical aid for the last six months of 1919 as related to the last six months of 1917 with the average wage increase for the same periods. The increase in the cost of medical aid is approximately 50 per cent. as compared with a wage increase of approximately 40 per cent., thus indicating the medical pure premium for 1917 should be increased approximately 7 per cent. to produce an adequate pure premium for 1919.‡

2. The justification for the decision to load the balance of the factor upon the all other pure premiums is found in the fact that

* Generally as the work progressed the factors developed for the several states were such that the committee decided not to attempt analyzing them.

† As it was worked out this proved to be 1.19.

‡ This study of medical cost was made for each state as a part of the projected study. In some cases a factor was recommended to be applied to the medical pure premiums because this study indicated a very slight increase and the committee had advices that larger medical changes were being approved or would be when the new rates became effective.

the conditions which are held largely accountable for the increase in the cost of compensation for 1919 as compared with 1917, viz., the decision in the Phonville case and the change in procedure adopted by the Industrial Commission following the Connor investigation, are substantially, but not wholly, limited in effect to the cases comprising the all other indemnity division of the total pure premium. We believe the D. & P. T. D. costs have also felt some effect of this and have therefore recommended a factor of unity for this element notwithstanding the effect of the fixed limits on the higher wage basis would otherwise have tended to reduce the pure premiums.

It would make this paper quite too voluminous to indicate the conclusion as to subdivision of the projection factor for each state but I believe this record of treatment in New York is a sufficient indication of the general method followed by the committee. Further, the work of projection of gross rates for all the states is not completed at this writing. If this point is further developed before the close of the work I shall be glad to elaborate the statement when the paper is up for discussion at the next meeting of the Society.

INVESTIGATION OF EFFECT OF WAGE INCREASE BY INDUSTRIES.

From the nature of the projection factor and its development, as above described, it will be apparent that this factor embodies within itself the composite effect of wage changes without change of limits in the Act, of changes in administrative procedure and construction and of any other like changes which may have occurred during the time interval bridged by this factor. It must be apparent from even a brief consideration, that the effect of fixed limits in any compensation act does not operate alike in all industries. In the industries having predominantly highly skilled and correspondingly well paid employees, the tendency is for the upper limit of the compensation act to reduce the effective ratio of compensation to wages, whereas the lower limit tends to increase that ratio in the industries characterized by unskilled and low-paid employees. An upward change in the general level of wages tends to make the upper limit more effective in the more highly skilled industries and to diminish the effect of the lower limit in the less skilled industries. It must, therefore, be apparent that when, as recently in the case of New York, the limits of the compensation act have remained unchanged and the general level of wages increased, the effect upon the pure premiums must vary by classifications.

This was considered by the Actuarial Committee, and the wage distributions for three divisions of industries during the last part of 1917 and the last part of 1919 were applied in a theoretical calculation to the terms of the New York Act to determine the independent effect of the change in wage level. Contrary to the expectations of the committee, the net effect was found to be approximately the same for all three groups of industries for which the wage data had been collected.

A study of the plotted curves of the wage distributions convinced me* that this result was due to the groups of industries for which the data had been collected not being sufficiently homogeneous. In response to request, certain of the companies furnished the necessary data to investigate the effect of the wage change by individual classifications and a considerable variation was found, but in the meantime the New York Legislature had amended the compensation act, increasing the limits; and, as will appear on reflection, the effect of such an amendment upon the compensation costs in the several classifications will be in direct opposition to the effect of the wage increases when the limits have remained fixed. Those industries receiving the greatest reduction in compensation costs by the operation of the old limits received the greatest increase by reason of the increase in limits, and vice versa. Our study proved this to be the case. This fact, and this alone, relieved us of the necessity of admitting a discrimination in the effect of wage changes by classification. In one way this was most fortunate as the labor involved in making the discrimination would have been very great.

AMENDMENT TO COMPENSATION ACTS.

Reference has been made to amendments having been passed in New York at the Session of 1920. It is obvious that, these amendments having been passed after the latest date (December 31, 1919) to which any statistical data had been brought, factors to measure the effect of the amendments must be derived from theoretical calculations. If our projection factor had taken account of the effect of wage changes by classification, it would be necessary to measure

* This supplementary study was made by Mr. Michelbacher and the writer and as it was earnestly desired to hasten the arrival at a definite conclusion was presented to the general rating committee without previous reference to the Actuarial Committee.

the effect of amendments changing benefit limits by classifications but since the projection factor did not so discriminate and, as noted above, the discriminating effect of the wages was in the opposite direction to the effect of law changes, this work was avoided.

Early in the committee's deliberation, it was recognized that there would probably be amendments which could not be measured by statistical data and would have to be allowed for by theoretical calculation, and it was decided by the committee that this calculation should be made along the lines heretofore generally followed in calculation of differentials, except that the differentials should be calculated for partial pure premiums rather than en bloc.

THE AMERICAN ACCIDENT TABLE.

For a considerable time prior to the sessions of the committee there had been more or less discussion of the adequacy of the Standard Accident Table for this work, and Mr. Michelbacher had suggested to Miss Olive E. Outwater, of the National Workmen's Compensation Service Bureau, the collection of American data and construction of an American table along the lines of the Standard Accident Table. This work was completed during the committee's sessions and brought to the attention of the committee. Through it, the table as prepared was promulgated for general criticism and corrections were made in it to meet certain criticisms that had been received. The committee then adopted the American Accident Table for the calculation of theoretical differentials.

Generally speaking, recent amendments to the compensation acts of the several states have been increases in the maximum limit of compensation, either throughout the entire schedule or for certain types of benefits, and it is important, in measuring the effect of such changes, that recent wage distributions should be used. I have heretofore referred to the committee's collection of wage-distribution data, and the committee decided that the projection factor brought the experience up to approximately present-day conditions and that calculations of amendment factors should be made upon the basis of 1919 (last half of year) wage-distribution data, either for the state in question or, if that was not available, for a neighboring state of similar industrial characteristics and economic conditions.

OCCUPATIONAL DISEASE COVERAGE.

Among the 1920 amendments of the New York law was an amendment bringing occupational diseases under the compensation act, and the committee, after due consideration, adopted the report of a special sub-committee appointed to make an investigation into this question. This report was as follows:

"It is recommended that no special factor be used in the rates to measure the cost of occupational diseases.

"The special committee looked particularly into the question of securing additional information on the subject from the records of the Industrial Board of Massachusetts and the Industrial Accident Commission of California. It failed to find any new data of value. This would make it necessary to refer back to the original report on this subject made by Mr. Maddrill in 1915.

"However, the committee felt that there was no necessity for doing this and that a decision to refrain from an attempt to measure the cost of occupational diseases was entirely warranted by the following considerations:

"1. The element is not of great importance. The most radical measure of the cost of occupational diseases so far made, places the total cost of this element as approximately 2 per cent. of the cost of accidental injuries.

"2. The California and Massachusetts experience used in the present revision contains occupational disease cases as the laws of these states contain specific provisions covering the subject. Notwithstanding this fact, the experience of these states shows no radically different results than the experience of other states where the occupational disease hazard is not specifically covered by statute.

"3. A large proportion of so-called occupational disease cases have already been carried into the experience. Such cases as lead poisoning and anthrax have, in many jurisdictions, been classified as accidents and compensated under the terms of the workmen's compensation law provided they occurred under certain conditions.* Proof of this is found in many individual death and permanent total disability cases, for which detailed reports are available.

"4. The distribution of occupational disease cases by classification is very unstable. In California, for example, the occupational diseases that did occur and were compensated in many cases were not covered by Mr. Maddrill's report. Many of them fell in classifications for which no specific loadings had been provided, thus producing inequities.

"5. A flat factor to apply to all rates could not be justified. Such treatment would involve discrimination as occupational dis-

* This is particularly true of infectious diseases. The scratch or abrasion through which infection entered is usually considered an accident and the infection a secondary result.

eases are particularly prevalent in certain industries and practically non-existent in others."

We have now disposed of the entire pure premium by states for the most recent law and at current level except for one element—the question of catastrophe cost. This element has for some time past been covered by a flat loading of 1 cent on the gross rate in all states, and the committee having no further data on the subject than heretofore available has continued this loading.

EXPENSE LOADING.

Having disposed of all these matters, the committee next gave consideration to the development of the gross rate, which involved the question of loading for taxes and expenses and the correction, if any, for the effect of schedule and experience rating. The committee decided, as respects schedule rating, that there should be a loading factor of the amount that a proper investigation of conditions in each jurisdiction indicated was necessary on account of the operation of the plan in that jurisdiction tending to disturb the average rate level,* to be used in the rates of classifications subject to the schedule.

As respects experience rating, the committee decided that there should be no loading in the premium to correct for a distorting effect of experience rating, but that the experience rating plan should be studied and adapted so as to produce a balance, or an approximate balance, in all cases. It felt that it is more possible to do so now than heretofore, because by discovery of the statistical method of developing the projection factor it was possible to bring up the experience of former years in the experience rating plan by a method which accurately corresponded to the way the data was handled in the rates so that the factors were based on the actual experience to which they were to be applied.†

As respects expense loadings, consideration was given to the methods heretofore in use of a graduated expense loading, by states,

* The Schedule Rating Plan has not yet been brought under such statistical control that it can be made to recognize proper distinctions in the physical condition of individual plants and not disturb the average level of rates. Until that time it seems to be necessary to let it take its own course and correct the manual rates to allow for its effect.

† Study of the experience rating plan was an interesting part of the committee's work but must be left for later presentation.

having regard to the scale of benefits in that state. After careful consideration, the committee decided that with the exception of the tax item it would recommend a single loading for all states. This decision involves the discontinuance of the present practice of making a variation of the expense loading dependent upon the size of the state law differential. The committee's reasons for this action were as follows:

1. There is no necessary relationship between law differentials and the expenses of administration. In fact, cases have been found where the law of variation which has been used in the past has produced results exactly contrary to the actual expense requirements.

2. Factors, other than the level of benefits in the individual state, are just as important, and in some cases more important, in determining the expense requirements of the carriers. Some of these items may be enumerated as follows:

- (a) Geography of the state.
- (b) Dispersion of risks.
- (c) Distribution of risks by kind of industry.
- (d) Requirements of administrative claim bodies in handling claims.

These factors are important in determining the cost of field work for the purpose of accident prevention, the adjustment of claims, and the auditing of payrolls. Difficulties of transportation, the necessity for long trips, the impossibility of making convenient itineraries for field work, and the various requirements imposed upon the carriers by administrative bodies in the adjustment of claims, vary so considerably, and without any regard to the level of benefits, that the use of a scale of expense ratios based upon variations in benefit levels is impracticable and may produce illogical results. Furthermore, the larger part of the expense loading varies directly with the gross premium, limiting the possible variation of the expense loading to only a share of the total cost.

The committee derived a single tax and expense loading* from

* This standard loading corresponded accurately in its total and approximately in its analysis to the actual returns and was:

	Per Cent.
For Acquisition expense	17.5
“ Home office administration	8.0
“ Claim investigation	7.0
“ Inspection and accident prevention	2.0
“ Taxes State 2 per cent. Federal and other 1½ per cent.	3.5
	38.0

the Schedule W returns, which this year, in contradistinction to other years, covered the entire country.

One exception was made to the recommendation of a flat tax and expense loading. The item of taxes other than federal taxes, including therein taxes or special charges for the maintenance of industrial commissions, is a matter within the control of the local legislatures, and the committee felt that it would be unwise, where the taxes were substantially above the average, to distribute this extra tax over the country, but that properly this tax should be assessed upon the premiums of the policy holders within the local jurisdiction. Accordingly, it was recommended that in those states where the tax rate, including special charges, exceeded the normal of 2 per cent. of the premiums, the loading for expenses and taxes should be increased above the standard loading by this amount. The actual standard loading, based upon Schedule W, was 38 per cent. of the gross premium, and the special additional items ran from 1 to 2 per cent., according to local provisions. This was the final decision necessary for the determination of the gross manual rates.

CONCLUSION.

The committee's work covered such a wide field that it is not possible suitably to summarize this account of its work in a closing paragraph. In noting each decision I have tried to bring out its bearing on the work as a whole. Reviewing it from my personal point of view, it seems to me that probably the outstanding features of the committee's work were:

1. The change in method of combining experience and translating the selected basic pure premiums into state pure premiums.
2. The development of statistical projection from earlier years of issue to conditions of more recent date.

It seems to me that with this work the pioneer stage of compensation ratemaking may be considered to have drawn to its close, foundations for future rates having been laid in actuarial and statistical studies of experience data to replace in the largest possible degree the exercise of empirical personal judgment. Looking to the future, it seems to me that the problem for the actuary and sta-

tistician is the development of labor-saving methods in carrying out the actual work and of methods for bringing attention more promptly to changes in conditions which call for revision of rates, thereby diminishing the lag which has heretofore, of necessity, existed between economic and industrial changes and the adjustment of compensation rates thereto. This last, more closely to follow the trend of experience, is our most important problem.