THE PRACTICE OF WORKMEN'S COMPENSATION RATEMAKING AS ILLUSTRATED BY THE 1939 REVISION OF NEW YORK RATES

BY

CHARLES M. GRAHAM

The method followed in revising Workmen's Compensation rates in the State of New York differs in some respects from the standard or National Council method. New York, however, is an industrial empire in itself. It produces the largest volume of workmen's compensation experience of any state in the Union. It seems fitting, therefore, to select the New York method of ratemaking as a vehicle for describing, in detail, the present *modus operandi* of workmen's compensation ratemaking.

The general subject may be conveniently divided into three parts, as follows:

PART I—An exposition of the basic principles governing the determination of manual rates.

PART II—The determination of classification relativity, i.e., pure premiums, which has always been done by the National Council on Compensation Insurance.

PART III—The determination of the final collectible rate level, the adjustment of the pure premiums as determined by the National Council to such level, and the determination of the final printed manual rates. This step also includes the determination of loss and expense constants.

PART I

The basic principles underlying the present method of rate determination in New York State were first enunciated on December 14, 1933 by the Actuarial Committee of the Compensation Insurance Rating Board by the passage of the following resolution on the date mentioned:

"RESOLVED: That in calculating the rate level for any particular revision, this principle shall be kept in mind as an ultimate goal: That from a specified date the unloaded premiums shall equal the losses in the aggregate."

On May 17, 1934, the Governing Committee of the Compensa-

tion Insurance Rating Board referred the following resolution, pertaining to the July 1, 1934 revision, to the Actuarial Committee, for its consideration:

"RESOLVED:

1. That the basic pure premiums based on the classification experience of policy years 1927-1931 inclusive, shall be keyed to the level of policy year 1932 developed to an ultimate basis both for medical and indemnity losses;

2. In accordance with the principle that rates shall be adequate to meet all losses over a period of years, rates as finally calculated shall contain a basic contingency loading of 2.5 points which shall vary according to the following conditions:

   (a) Beginning with calendar year 1933 and including all subsequent calendar years, a record shall be kept of the accumulated profit or loss resulting from a realized loss ratio less than or greater than 60%.

   (b) The basic contingency loading of 2.5 points shall vary with the accumulated profit or loss thus determined from a minimum of zero when the accumulated profit is equal to 2.5% of the earned premium of the latest calendar year, to a maximum of 5.0 points when the accumulated loss is equal to 2.5% or more of the earned premium of the latest calendar year."

On May 23, 1934, the Actuarial Committee of the Compensation Insurance Rating Board, considered the foregoing action of the Governing Committee and adopted the following resolution:

"WHEREAS, this Committee on December 14, 1933 adopted the following resolution—

RESOLVED, that in calculating the rate level for any particular revision, this principle shall be kept in mind as an ultimate goal: That from a specified date the unloaded premiums shall equal the losses in the aggregate,

RESOLVED, that it is the sense of this Committee that we adopt a consistent plan to be followed in all future rate revisions beginning with the contemplated revision on July 1, 1934, the plan to embody the following principles:

1. That the basic pure premiums based on the classification experience of the latest available five policy years shall be keyed to the level of the latest policy year developed to an ultimate basis both for medical and indemnity losses;

2. In accordance with the principle that rates shall be adequate and reasonable to meet all losses over a period of years, rates as finally calculated shall contain a basic contingency loading of 2.5 points which shall vary according to the following conditions:

   (a) Beginning with calendar year 1933 and including all subsequent calendar years, a record shall be kept of the accumulated profit or loss resulting from a realized loss ratio less than or greater than the permissible;

   (b) The basic contingency loading of 2.5 points shall vary (rounded off to the nearest half point) with the accumulated profit or loss thus determined from a minimum of zero when the accumulated profit is equal to 2.5% of the earned premium of the latest *calendar* year, to a maximum of 5.0 points when the accumulated loss is equal to 2.5% or more of the earned premium of the latest *calendar* year;"

The foregoing procedure was followed consistently in the New York revisions effective July 1st of each year from 1934 to 1938 inclusive. Meanwhile, there had been considerable discussion regarding the propriety of using the exact experience indications of Part IV of the Casualty Experience Exhibit to determine the realized profit or loss, which, in turn, determined the contingency factor*. The calendar year experience in Part IV of the Casualty Experience Exhibit, included not only actual changes in estimates of incurred loss, but also additions to incurred losses made necessary because of the fact that the reserves on many cases had been calculated on a discounted basis. Exhaustive tests were made to measure the increase in incurred losses resulting from the revaluation of the incurred losses on cases originally set up on the basis of discounted reserves. At the meeting of the Actuarial Committee of the Compensation Insurance Rating Board, held on Thurs-

* For a complete treatment of this subject, the reader is referred to Mr. Cahill's paper, "Contingency Loading—New York Workmen's Compensation Insurance," in this issue.

day and Friday, March 9 and 10, 1939, the following motion was passed:

> "That in calculating the contingency factor for the 1939 rate revision the figures for each calendar year shall be modified to recognize the interest discount for tabular cases of those policy years developed to more than sixty months in each calendar year."

A recalculation of the indicated calendar year profit or loss, chargeable to policy years developed more than sixty months, eliminating the upward revision in losses due solely to the effect of interest discount, changed the picture materially, indicating that the contingency factor, which had been 5.0 points, would be removed entirely in the rate revision effective July 1, 1939. This was almost entirely due to the excellent experience of calendar year 1938, as tests indicated that the contingency factor would have remained at 5.0 points for all rate revisions prior to the 1939 revision had the interest discount adjustment been in effect since the beginning of the present ratemaking program in 1934.

Discussion in the Actuarial Committee developed the point that it was considered undesirable to discontinue the entire contingency factor of 5.0 points at one particular time due to the possibility that this factor or a part of it might have to be reintroduced at the next rate revision. In order to insure some degree of rate stability, and further bearing in mind that the elimination of the contingency factor was solely due to the introduction, for the first time, of the principle of eliminating the increase in incurred losses of older years due to interest discount, the Committee amended paragraph 2(b) of its resolution of May 23, 1934, by adding the following phrase:

> "; provided, however, that the contingency loading shall not differ by more than 2.5 points from the contingency loading in the preceding rate revision."

This means, in brief, that the basic program as respects ratemaking, which was originally adopted in 1934, has been modified in only two respects up to the present time; first, by eliminating from the incurred losses as reported in the Casualty Experience Exhibit—Part IV, the amounts incurred by reason of the constantly increasing cost of cases on which discounted reserves were originally set up and which cases are chargeable to policy years

developed more than sixty months; and second, by limiting the change in the contingency factor to 2.5 points in any one revision. The basic program, adopted in 1934 is otherwise in full force and effect at the present time.

PART II

The first process in the making of New York Manual rates is the determination of classification relativity, or, in other words, pure premiums for the various classifications which are included in the New York Manual. Certain classifications are subject to special ratemaking treatment and are, therefore, not included in the standard ratemaking process and will not be covered in this paper. These classifications include maritime coverages and "a" rated classifications.

Classification experience is compiled by the Compensation Insurance Rating Board from reports under the New York Unit Statistical Plan and is published and circularized to member carriers in bound form. Complete data are shown, covering payrolls exposed, both on a full coverage and ex-medical coverage basis; premiums earned, on both bases mentioned; loss and expense constants; and losses incurred, separated between indemnity and medical and further separated by kind of injury. Occupational disease experience is also shown, but is not included in the ratemaking procedure herein described. A separate ratemaking procedure is followed for the determination of supplemental occupational disease charges for classifications having a substantial dust disease hazard. Classifications not having a substantial dust disease hazard have a percentage charge added to the classification rate as hereinafter explained.

For the revision of New York rates, effective July 1, 1939, the National Council on Compensation Insurance received from the Rating Board, the classification experience of policy years 1932 and 1933, based on the fourth and final reports under the Unit Statistical Plan; the experience of policy year 1934, based on third reports; of policy year 1935, based on second reports; and of policy year 1936, based on first reports. From this classification experience, the National Council eliminated all discontinued and unassigned classifications, all "a" rated classifications and all maritime classifications. These classifications are known as

standard exclusions and are always excluded from both the experience used in computing group rate levels and the experience used in computing classification pure premiums. Ex-medical earned premiums are adjusted to a full coverage basis by dividing such premiums by the complement of the current ex-medical ratio. This adjustment is made only in classifications in which the ex-medical payroll exceeds ten percent of the total payroll. In other classifications no adjustment is made.* Revenue due to loss and expense constants, and to the general catastrophe loading of 1¢, is eliminated. The actual earned premiums are then summed by policy year and by industry group to produce the actual earned premiums shown in Column I of the premium and loss exhibits, by policy years, and industry group. There are five industry groups in the July 1, 1939 New York revision, as follows:

1. Manufacturing
   (Schedule Groups 050 to 253, inclusive).
2. Contracting
   (Schedule Groups 260 to 279, inclusive).
3. Stevedoring (or "Federal") (Including Ship Building)
   (Schedule Groups 280 and 300—also Classifications 8709 and 8726 from Group 353).
4. Servants—Per Capita
   (Classifications 0912 and 0913 only).
5. All Other
   (All remaining groups and classes excepting standard exclusions).

The actual incurred losses for those classifications in which the ex-medical payroll exceeds ten percent of the total payroll are then adjusted to a full medical basis by applying the latest national medical pure premiums, corrected to the New York level, to the payrolls exposed under ex-medical coverage to produce medical expected losses, which are then combined with the actual medical losses incurred on full coverage policies.*

Excess catastrophe losses (losses arising from accidents involving serious injuries to two or more persons) are eliminated by the following method:

(1) If the total indemnity cost is less than twice the average value of death and permanent total cases for the policy year in question, no adjustment is made.

* Refer to Appendix B for a suggested change in this practice.

(2) If the total indemnity cost exceeds the amount determined as above, the two most costly cases are included provided they equal or exceed twice the average value. Sufficient additional losses are added, if necessary, to equal twice the average value. Excess losses are eliminated.

(3) All medical losses are included without adjustment.

The losses are then tabulated and are adjusted by factors which will bring them to the expected level of the final or fourth report of experience. As policy years 1932 and 1933 are already based on fourth reports, no development factors are necessary. Policy year 1934 is developed from third to fourth reports, using factors calculated as averages of the last two years available on a fourth report basis, namely, policy years 1932 and 1933. Policy year 1935 is developed from a second to fourth report basis by using development factors applicable to policy year 1934 multiplied by development factors from second to third reports, which are calculated as the average of the developments for policy years 1933 and 1934. 1935 development factors are applied to 1936 with an additional multiplier from first to second reports, based on the experience of policy years 1934 and 1935 combined. Incurred losses so developed are shown in Column 2 of the premium and loss exhibits by policy years, as actual incurred losses.

It is next necessary to determine the industry group loss ratios on the basis of existing collectible rates. The process is as follows:

1. The printed manual rates of July 1, 1938, are corrected for subsequent interim changes up to and including April 22, 1939.
2. From the corrected rates are deducted, (a) the flat catastrophe loading of 1¢, applied to all classification rates in New York State; (b) the general occupational disease loading of 1% (subject to a minimum limit of 1¢, a maximum limit of 5¢).
3. The rates thus reduced are extended by the policy year classification payrolls.
4. The premiums thus produced are divided by a combined factor, composed of, (a) the element applied to the July 1, 1938 rates to offset the premium produced by loss and expense constants; (b) the element applied to offset the off-balance of the experience rating plan; (c) the factor for the security funds; (d) a factor making adjustment from the permissible loss ratio of 60.5 for New York State to the standard permissible loss ratio of 60%.

This process gives classification premiums by policy year based on July 1, 1938 collectible rates, and these are entered in Column 4 of the premium and loss exhibit.

The losses of the same classifications are then adjusted to the level of the benefits provided by the New York law as of July 1, 1938, by the use of amendment factors computed on the basis of the American Accident Table. These losses, as previously stated, have already been developed to a fourth reporting basis. The only remaining step for the completion of the premium and loss exhibits, is to convert the medical losses to the level indicated by the last policy year, i.e., policy year 1936. This is done by adjusting the medical losses from the loss ratio level of each policy year to the loss ratio level of the last policy year. The factors are actually computed on the basis of all industry groups combined by adding the premiums at July 1, 1938 collectible rates, and the losses on the July 1, 1938 law level and on a developed basis, and determining the medical loss ratio by policy year for all industry groups combined. The ratio of the medical loss ratio for each of the first four years to the latest year, determines the medical projection factor, which is then applied to the medical losses to place them on the level of policy year 1936. The medical losses so converted, added to the indemnity losses on the July 1, 1938 law level, produce the losses shown in Column 5 of the premium and loss exhibits, attached to the National Council's memorandum dated April 22, 1939.

It is next necessary to determine the group rate level loss ratios on the basis of the last two years of experience available and to adjust these loss ratios so that they will reproduce the loss ratio of the last year for all groups combined. At this point it will probably be of interest to mention that the standard ratemaking procedure, as practiced by the National Council, establishes a minimum premium qualification of $1,000,000 for the establishment of an industry group rate level loss ratio on the basis of the group experience exclusively. Where the industry group premium falls below $1,000,000, the selected loss ratio for the industry group is determined by taking a percentage of the group loss ratio indications and the complement of this percentage of the loss ratio indications for all groups combined. Since, however, each industry group in New York produces premiums in excess of

$1,000,000, this computation is not needed and will not be discussed further. The actual process of adjustment involves the determination of the industry group loss ratios on the basis of the last two available policy years, 1935 and 1936, based on July 1, 1938 collectible premiums, and incurred losses on the July 1, 1938 benefit level (excluding, however, the medical projection inasmuch as that is taken care of in the loss ratio adjustment). The industry group loss ratios, based on the two years mentioned, are then applied to the premiums of policy year 1936 at the July 1, 1938 collectible level, to determine formula expected losses. These losses are then summed for all groups and are compared to the policy year 1936 premiums for all groups to determine the total loss ratios for all groups based on the premium distribution of the latest policy year. The loss ratio of all groups for policy year 1936, which is the temporary rate-level basis, is then divided by the policy year 1936 loss ratio for all groups determined as heretofore described, and the indicated adjustment factor is applied to each industry group loss ratio based on the experience of policy years 1935 and 1936 combined to determine the loss ratio to which the classifications in each industry group will be keyed. These loss ratios are shown on page 2 of the National Council's memorandum and are as follows:

INDUSTRY GROUP LOSS RATIOS — NEW YORK

Industry Group	1935 - 36 Loss Ratios Adjusted to Reproduce 1936 Loss Ratio Over All		
	(1) Indemnity	(2) Medical	(3) Total
Manufacturing	36.3	19.3	55.6
Contracting	40.8	14.1	54.9
Stevedoring (or "Federal")	42.2	14.8	57.0
Servant Per Capita	44.4	16.9	61.3
All Other	36.6	18.1	54.7
All	37.6	17.5	55.1

Having calculated the premium and loss exhibits and determined the industry group rate levels therefrom, it is next necessary to prepare the classification experience, converted to these rate levels, with sufficient additional comparative information respecting national pure premiums, pure premiums indicated by the formula (which will be hereinafter described), pure premiums

underlying the present rates and the pure premiums recommended for adoption, so that pure premium selections may be made by the Classification and Rating Committee of the New York Board, to serve as the basis of the July 1, 1939 rates. In order to do this, use is made of the same basic data as enters into the preparation of the premium and loss exhibits. Payrolls, however, are tabulated rather than premiums because of the fact that pure premiums are quoted in $100 units of payroll.

The experience of each classification is now available with losses converted to the law level of July 1, 1938. Rate levels for each of the five industry groups have been determined. From the figures which were prepared in determining the rate level of each industry group, projection factors are calculated for each industry group as a ratio of the temporary rate level loss ratio (policy year 1936) to the loss ratio of each of the policy years. Since all of these loss ratios are on a developed basis, it is necessary again to multiply in the loss development factors, due to the fact that these factors cancel out in the determination of the projection factor, and the factors are to be applied to actual undeveloped losses. The actual projection and development factors used, are shown at the bottom of page 3 of the National Council's memorandum of April 22, 1939.

It is next necessary to determine the amount of credibility which will be given to the experience of each of the classifications that are being reviewed. In order to have a uniform credibility standard, the average costs of serious cases (death, permanent total and major disability cases), and non-serious cases (minor permanent and temporary total disability cases) have been determined by dividing the number of such cases included in the Unit reports for the five year experience period, into the losses converted to the July 1, 1938 benefit level developed to fourth report and adjusted to the temporary rate level for each industry group. All groups added together, however, are used for the determination of these figures. The result is an indicated average cost of $5,071 for serious cases, and $186 for non-serious cases. It has been determined, purely on actuarial and underwriting judgment, that 25 serious cases and 300 non-serious cases, based on the averages mentioned, should be sufficient to allow a classification to be rated on its own experience. The medical criterion for classification

self-rating has been arbitrarily taken at 80% of the value for non-serious. The computations result in establishing the following figures for full credibility on the manual rate level:

Serious.....126,775 Non-Serious.....55,800 Medical.....44,640

In order to have a standard basis for determination of classification credibility, it is necessary that the expected losses for full credibility be determined on the basic level on which national pure premiums have been established. This basic level is now 25% above the New York 1927 level. The 1932 to 1936 payrolls have, therefore, been extended at the present national pure premiums on basic level (which are based on policy years 1930 to 1934, inclusive), to produce the total expected losses on basic level for the three pure premium divisions; serious, non-serious and medical. These expected losses, on the basic level, are then divided by the actual state losses on the manual rate level, to produce factors to adjust the credibility criteria to the basic level. The indicated criteria for full credibility, on the basic level, and the adopted criteria, are as follows:

	Actual Indications	Adopted Figures (Rounded)
Serious	132,226	132,200
Non-Serious	61,380	61,400
Medical	34,641	34,600

Eight credibility groups have been used in computing New York pure premiums, as follows:

Credibility Group	State Credibility	Volume of Expected Losses (Manual Rate Level)		
		Serious	Non-Serious	Medical
A	100%	126,775	55,800	44,640
B	75%	95,081	41,850	33,480
C	50%	63,388	27,900	22,320
D	25%	31,694	13,950	11,160
E	20%	25,355	11,160	8,928
F	15%	19,016	8,370	6,696
G	10%	12,678	5,580	4,464
H	0% Less Than	12,678	5,580	4,464

The credibility criteria given above are stated on the New York level. The fact that the credibility groups are actually determined

on the basic level makes no difference in the final result, as the credibility criteria have been adjusted, as explained above, by the difference between the total state losses and the expected losses indicated by the application of the national pure premiums to the state payrolls. In this connection, it should be borne in mind that the expected losses must be corrected to the state actual losses in any event, so far as the total experience is concerned.

The actual state experience is exhibited by classification and policy year in order within industry group. Payrolls are shown to the nearest $100, with the number and amount of serious and non-serious losses, the amount of medical losses, and the indicated pure premiums for each policy year for the total losses combined. The pure premium indications of policy years 1932-1936 are also shown on the industry group rate level adjusted to the 1936 loss ratio indications. An exhibit of this kind is prepared for each New York classification on which any part of the total pure premium (serious, non-serious or medical) receives any credibility whatsoever. The credibility group is indicated on the classification experience exhibit by a capital letter typed immediately after the word "serious," "non-serious" or "medical," which indicates the respective loss and pure premium columns. Those classifications in which the volume of experience is so small as to indicate no local or state credibility, are termed the "non-reviewed" classes and are not shown. These classifications are reviewed by the Compensation Insurance Rating Board to determine whether any of them are to have pure premiums established by analogy to other classes or by special underwriting treatment. Otherwise, the national pure premiums are recommended for adoption.

In order to complete the classification experience exhibits, it is necessary to calculate average reversion factors for each industry group and for each pure premium division to measure the departure of the expected losses on the national level from the actual losses on the manual rate level to the extent to which national experience is used in lieu of state experience. This is accomplished by applying the national credibility (which is the complement of the state credibility) to the actual losses on manual rate level and to the expected losses on the national or basic level, summing the results and dividing the actual losses on manual rate

level so obtained by the expected losses on the national or basic level. The result may be described as a combined reversion and correction factor which brings the national pure premiums (to the extent to which they are used) to the level of that portion of the aggregate New York State experience which was not used in determining pure premiums. These factors are applied to the national pure premiums on the basic level to place them on a comparable basis with the actual New York experience. The result is shown on the line captioned "P.P.: National," on the classification experience exhibits.

The formula pure premiums, as shown on the classification experience exhibits, are computed by taking the appropriate percentages of the New York State indications according to the credibility symbol, and the complementary percentages of the national pure premiums. If a classification qualifies for 100% state credibility throughout, the formula pure premiums are the same as the state indications. If the classification qualifies for 50% credibility, as respects the serious pure premium, and 100% credibility as respects the non-serious and medical pure premiums, the non-serious and medical pure premiums would be the same as the state indications while the serious pure premium would be computed by taking one-half of the national pure premium and adding it to one-half of the state indications, or, in other words, taking 50% of the difference between the national and state indications and adding it to the lower of the two.

The classification exhibit next shows the pure premiums underlying the existing, or July 1, 1938, rates on the same level as the new indications. These pure premiums are computed by adjusting the selected pure premiums for the 1938 revision to the level of the formula and proposed pure premiums as follows:

(1) The rate increase, effective July 1, 1938 which included the factor of 1.012 for the security fund, was 1.017. The test of the new pure premiums computed by the National Council, indicated a level of .928 when compared to those in force prior to July 1, 1938. Dividing the rate increase of 1.017 by the pure premium test factor of .928, produced a factor of 1.096 to adjust the selected pure premiums for the July 1, 1938 revision to the final rate level.

(2) The industry group rate levels for the current (July 1, 1939) revision, were determined by applying the July 1,

1938 rates less catastrophe and occupational disease loadings and further reduced by dividing the remaining portion of the rate by the product of the offsetting reduction, the security fund factor and the expense constant factor. The loss ratios to which these rate levels are keyed, compare with the permissible loss ratio of 60.0% as follows:

Manufacturing	.927
Contracting	.915
Stevedoring	.950
Servant Per Capita	1.022
All Other	.912

The above factors would normally be multiplied by the factor of 1.096, which was used in 1938, to adjust the selected pure premiums to the rate level. However, the security fund factor—1.012, must be divided out of the factor of 1.096 and the quotient should then be multiplied by the industry group rate level changes listed above. This produces the following factors which have been applied to the July 1, 1938 pure premiums to indicate the pure premium underlying existing rates on the same level as the other pure premiums shown on the classification experience exhibits:

Manufacturing	1.0036
Contracting	.9907
Stevedoring	1.0284
Servant Per Capita	1.1069
All Other	.9877

The July 1, 1938 pure premiums modified by these factors appear on the line captioned "P.P.: Underlying Present Rate."

The last line of the classification experience exhibits on which pure premiums have been entered, shows the pure premium selections of the combined staffs of the Compensation Insurance Rating Board and the National Council. While the Committee exercises some judgment in making these selections, the basic method employed is to compare three pure premium indications: first, the state indications; second, the formula pure premium; and third, the pure premium underlying the present rate. For self-rating classifications, the formula and state indications will, of course, be the same and except in very rare instances, will be the Committee's selection. In other cases, the Committee generally

selects that pure premium which lies between the other two pure premiums being considered. In other words, if the formula pure premium is below the pure premium underlying the present rate, but the state indications are above the pure premium underlying the present rate, the present pure premium will be reaffirmed.

After the pure premiums have been selected by the combined staffs, a test of the effect of these pure premium selections is necessary. To accomplish this, it is necessary that the expected losses underlying the existing rates be determined. These are determined by subtracting the occupational disease and catastrophe loadings from the July 1, 1938 manual rates, extending the rates so modified by the policy year 1936 payrolls by classification, and dividing the premiums so obtained by the composite factors shown below:

Industry Group	(1) Off-balance and Offsetting Reductions	(2) Expense Multiplier 1.0 ÷ .605	(3) Security Fund Loading	(4) Composite Factor (1) × (2) × (3)
Manufacturing ...	.9841	1.653	1.012	1.6452
Contracting	.9953	1.653	1.012	1.6650
Stevedoring	1.0000	1.653	1.012	1.6728
Servant Per Capita	1.0000	1.653	1.012	1.6728
All Other	.9474	1.653	1.012	1.5848

It will be noted that the composite factors shown above, are identical with the factors used in preparing the premium and loss exhibits with the exception that the expense loading is also removed, as we are now dealing with expected losses, whereas in the premium and loss exhibits we were dealing with collectible premiums.

The formula pure premiums and the pure premiums proposed by the combined staffs of the Rating Board and Council, are then multiplied separately by the 1936 payrolls, and ratios of the formula pure premiums, and the proposed pure premiums, to the present pure premiums are determined by industry group separately for reviewed and non-reviewed classes, and also in total. These ratios represent a comparison of the pure premium selections with the pure premium selections underlying the existing rates, in terms, however, of the industry group loss ratios keyed to the total loss ratio of all industry groups for policy year 1936. The ratios, therefore, must be modified by any further adjustment

which is made from the loss ratio of policy year 1936 for each industry group, to the final adopted loss ratio which is to underlie the July 1, 1939 rates, plus whatever contingency factor is to be adopted, any amendment factors which are introduced into the rates after the pure premiums have been determined, and such adjustments as are to be made in the collectible rate level because of the off-balance of the Experience Rating Plan and the effect of loss and expense constants. These adjustments will be discussed in Part III of this paper.

The selections of the combined staffs of the Rating Board and the National Council are reviewed by the Classification and Rating Committee of the Compensation Insurance Rating Board, which has the final decision with respect to the selection of pure premiums for individual classifications. The Committee makes, as a rule, very few changes in the selections of the combined staffs of the Rating Board and the National Council.

For those classifications for which no classification experience exhibit is prepared, the national pure premiums will normally apply. The only exceptions to this rule would be classifications which might be rated by analogy to other classifications, or possibly New York special classifications where the experience is not broad enough to receive credibility.

At this stage of the ratemaking procedure, the determination of classification relativity has been completed.

PART III

In Part II of this paper, the process of determining classification relativity, i.e., the determination of pure premiums keyed to the 1936 policy year experience of the five industry groups, was described. It is now necessary to determine, first, the final rate level change, and second, the apportionment of the rate level change in such a manner that when the revenue accruing from loss and expense constants on risks producing annual premiums of less than $500, is allowed for, and the premiums on risks over $500 in size are properly modified for the effect of the additional premium accruing from loss and expense constants and also for the expected off-balance of the Experience Rating Plan, the loss ratios of the group of risks under $500 in annual premium size

and the group of risks over $500 in annual premium size, will be approximately equalized.

To accomplish the first step in the determination of the final rate level, it is necessary to determine the indicated rate level change based on the developed experience of policy year 1937. This is done by compiling the earned premiums and incurred losses reported by all carriers in the call for loss ratio data as of December 31, 1938. These data indicated (as of 24 months development) the following figures:

Earned Premium	$78,547,607
Indemnity Losses	28,624,811
Medical Losses	12,570,475
Indemnity Loss Ratio	36.44%
Medical Loss Ratio	16.00%
Total Loss Ratio	52.44%

The above figures must be developed to an ultimate basis. This is considered to be development to 60 months from the beginning of the policy year. Development factors are determined by calculating separate factors for premiums earned, indemnity losses incurred and medical losses incurred for the two latest years available for the development period required. In other words, from the experience of policy years 1933 and 1934, development factors from 48 months to 60 months are determined. From the combined experience of policy years 1934 and 1935, development factors from 36 to 48 months are determined while the development factors from 24 to 36 months are based on the combined experience of policy years 1935 and 1936. The product of the three sets of development factors determines the selected development factors to be applied to premiums, indemnity losses and medical losses for policy year 1937 to develop them from 24 months to 60 months. New loss ratios are calculated based on the developed experience and these loss ratios are then adjusted for the effect of the increases in rate level effective July 1, 1937 and July 1, 1938 modified by a factor of 1.012 to cover payments to the security funds. After this adjustment is made, the final loss ratio to which the new rates would be keyed, is determined to be 52.42%.

As outlined in Part I, the contingency factor is determined on the basis of the calendar year underwriting results of all carriers, beginning with calendar year 1933 and terminating with calendar year 1938, with an adjustment eliminating the effect of interest discount on outstanding losses valued on a present value basis for all policy years developed beyond 60 months. Developments in special reserves for interest discount exclusively, reported by carriers maintaining such reserves, are also eliminated. That portion of the premiums earned which accrued from the introduction of the factor for the security funds is eliminated from the premiums earned for those years during which this factor was required. The premiums earned as modified by the exclusion of the security fund premium, are then compared directly with the losses incurred to determine the calendar year profit or loss by multiplying such premiums by the permissible loss ratio of 60% and adjusting the result to eliminate the increase in incurred losses which occurred solely from the increases in discounted reserves on policy years developed more than 60 months, also removing all adjustments in reserves held by certain carriers for interest discount exclusively. The result is a calendar year profit of $7,120,875 for calendar year 1938, which, when combined with an accumulated underwriting loss of $3,933,407 for calendar years 1933 to 1937 inclusive, indicates an accumulated underwriting profit of $3,187,468 for the period from January 1, 1933 to December 31, 1938. As this amount is more than 2.5% of the 1938 earned premium (excluding the security fund factor) of $77,278,200, the maximum reduction of 2.5 points in the contingency factor is indicated. This means, in brief, that the permissible loss ratio used in calculating the 1939 rate level change is to be 57.5%.

Before determining the actual rate level change, it is necessary to introduce the factor of 1.012 to provide for the premiums to be paid into the security funds and also to introduce the factor of 1.003 to provide for the special assessment for the reopened case fund provided for under Chapter 252 of the Laws of 1939. Therefore, the indicated rate level change is arrived at as follows:

$$\text{Indicated Rate Level Change} = \frac{52.42\%}{60.0\% - 2.5\%} \times 1.012 \times 1.003 = .925.$$

It should be borne in mind that at the last revision, this rate level change was determined at a time when certain law amendments were pending. Such of these law amendments as were subsequently enacted into law were, therefore, introduced into the rate structure at a later date and will be covered in subsequent paragraphs of this part of the paper.

Having determined the adjustment in the general collectible level of rates, we now proceed to apportion this change in rate level in such a manner that the loss ratios of non-experience rated risks (less than $500 annual premium) will be equivalent to the loss ratios of experience rated risks (risks with an annual premium of $500 or more) and so that the aggregate premium on all business will produce the permissible loss ratio for the state. In order to do this, it is necessary to determine the loss ratios of the two groups of risks involved, within each industry group. This is accomplished by the following steps:

I — Calculation of Premium Excess to be used for the Determination of Offsetting Reductions and Loss Constants.

(a) The experience of the last three policy years available on Unit reports, namely, 1934, 1935 and 1936, is used.

(b) The calculations are made separately for each industry group and within each industry group for risks with premiums of less than $500 and for risks with premiums of $500 or more per annum.

(c) The classification payrolls are multiplied by the selected pure premiums, times the expense loading adjusted by the factor to translate the selected pure premiums to the rate level. This latter factor is determined by dividing the rate level change, as determined above, by the factor determined from the National Council's test of the selected pure premiums (after adjustment to divide the security fund factor of 1.012 out of the result of the pure premium test). The National Council's test, indicating a factor of .919, divided by the security fund factor of 1.012, produces a factor of .908, which, when divided into the indicated change in the collectible rate level of .925, produces a factor of 1.019 to adjust the selected pure premiums to the rate level. The total premiums at full proposed rates so determined, appear in Sheet 1 of Exhibit 5, of the calculations of the 1939 revision.

(d) Indemnity losses incurred are determined by eliminating

the excess portion of the catastrophe losses by the same method as was used by the National Council in preparing the pure premium exhibits.

(e) Medical losses are adjusted to a full coverage basis by multiplying the total premiums by the medical loss ratio indicated on business subject to full medical coverage only.

(f) Actual loss ratios are then determined for risks under $500 and for risks of $500 and over within each industry group. These loss ratios are then adjusted to the permissible loss ratio for each group total.

(g) The excess or deficiency of premiums is then determined by dividing the adjusted losses for risks under $500 and for risks of $500 and over by the permissible loss ratio and subtracting the result from the total premium at full proposed rates. This indicates the amount by which premiums on risks under $500 must be increased which, of course, equals the amount by which premiums on risks of $500 and over must be decreased, to equalize the loss ratios of the two groups of risks within each industry group at the permissible loss ratio for the state as a whole.

(h) The number of risks under $500 and the number of risks of $500 and over within each industry group, is then determined by adding the number of full term policies to the number of short term policies adjusted to a full term basis. The adjustment of the short term policies is accomplished by decreasing the number of policies by a factor measuring the total length of the short term policy periods as related to the total length of the standard one-year policy term on the same number of policies.

II — The indicated off-balance of the Experience Rating Plan is then determined by industry group from tabulations based on ratings effective July 1, 1938 to June 30, 1939, in which are shown the subject premium, expected losses, and the adjusted losses. The division of the adjusted losses by the expected losses produces the percentage of modification produced by the Experience Rating Plan during the period in question. The indications are as follows:

Industry Group	Percent of Credit Off-Balance
Manufacturing	2.91
Contracting	8.26
Federal	3.01
Servants—Per Capita	.40 (Debit)
All Other	6.17
Total All Groups (Weighted)	5.30

III — The average credibility of all risks subject to experience

rating covering ratings effective from July 1, 1938 to June 30, 1939, is next calculated by industry group.

(a) The risks are tabulated by size groups and the normal and excess ratios are shown for each size group.

(b) The average normal and excess ratio for all size groups contained in each industry group, is determined by multiplying the normal and excess ratios respectively by the total unweighted premium shown on the actual ratings for each size group, and dividing the total of the normal and excess unweighted premiums respectively, by the total of the total unweighted premiums.

(c) The actual number of risks is tabulated for each size group within each industry group and the total for each industry group is arrived at by summation.

(d) The average risk unweighted premium for each size group is then determined in total, and for normal and excess, by dividing the number of risks into the total, normal and excess unweighted premiums as previously determined.

(e) The credibility factors (Z_n and Z_e) are then determined for the average risk in each premium size group and are weighted by multiplying these credibility factors by the normal and excess unweighted premiums respectively. These products are then summed for all groups and are divided by the total of the normal and excess unweighted premiums to arrive at the average normal and excess credibility for each industry group.

(f) The average credibility for normal and excess respectively, is then weighted by the average normal and excess ratios to arrive at the average credibility (Z) for each industry group.

IV — It is now necessary to determine the effect of the change in the medical excess ratio from .25 to .35, on the average credibility. It can be easily demonstrated mathematically that the revised average credibility is equal to the originally determined average credibility minus the product of the excess of the average normal credibility over the average excess credibility, multiplied by the change in medical excess ratio times the ratio of the medical losses incurred to the total losses incurred. This is proven by the formulæ shown for the determination of the effect of changing the medical excess ratio in Appendix A, Part 2. We, therefore, proceed as follows in determining the revised average credibility:

(a) The statutory medical coverage losses for each industry group, as determined in Exhibit 5, Sheet 1, are compared with the total losses incurred from the same source and

the product is multiplied by the change in the medical excess ratio (10%) to determine the effect of the change in medical excess ratio on the total losses incurred.

(b) The average credibility, normal, excess and total, is then entered and the revised average credibility is determined by the formula as outlined above.

V — Loss constants and offsetting adjustment factors based on experience of policy years 1934, 1935 and 1936 combined are now calculated.

(a) The details of this calculation are shown in Exhibit 10, of the 1939 Rate Revision Calculations, as revised May 3, 1939.

(b) The full premium at proposed rates for risks of $500 annual premium or over, and the indicated excess premium on such risks, separately for each industry group, are taken from Exhibit 5, Sheet 1, of the 1939 Rate Revision Calculations. It should be noted at this point, that where the Actuarial Committee adopted different loss constants than those indicated by the original calculations, it was necessary to force the indicated excess premium so that the adopted loss constant would be reproduced.

(c) We next determine the value of "*e*" as used in the formulæ for the calculation of offsetting reductions as set forth in Appendix A, attached. In the appendix, the formula value shown, is "1 — *e*," but the value of "*e*" shown in the actual calculations is, of course, merely the complement of the formula value. This value is determined by dividing the adopted excess (where the adopted excess differs from the indicated excess, as explained above) by the full premium at proposed rates and subtracting the result from unity. The resulting value of "*e*" is the direct reduction factor necessary to reproduce the permissible loss ratio for the risks with premiums of $500 or more per annum, if no loss constants were to be introduced or no off-balance of the Experience Rating Plan had to be considered.

(d) We next enter:

1. The offsetting adjustment factors (*a*) used in the July 1, 1938 rates.
2. The average credibility (*Z*), as originally determined.
3. The average credibility reflecting the change in the medical excess ratio (Z_r).
4. The 1938-1939 credit off-balance of the Experience Rating Plan (*b*).

The determination of all the above values, except last year's offsetting adjustment, has been described previously.

(e) The 1938-1939 credit off-balance of the Experience Rating Plan must then be adjusted to reflect the change in the average credibility brought about by the increase in the medical excess ratio. Again it is easy to demonstrate mathematically that this change will be equal to the original off-balance plus the revised average credibility minus the original average credibility.

(f) For purposes of computation, we then deduct from the revised average credibility the amount of the revised 1938-1939 credit off-balance.

(g) It is next necessary to remove from the estimated 1938-1939 credit off-balance, the effect of the offsetting adjustment in the 1938 rates. This is done in accordance with Formula I, as shown in Appendix A, by deducting from the revised average credibility, the excess of the revised average credibility over the revised off-balance, multiplied by the offsetting adjustment included in the July 1, 1938 rates.

(h) We may then determine from Formula II, the indicated offsetting adjustment (a_2) for the revised rates. Formula II demonstrates mathematically that this offsetting adjustment is produced by dividing the sum of the value of "e" and the estimated 1938-1939 credit off-balance, if there had been no offsetting adjustment in July 1, 1938 rates, reduced by the value of the revised average credibility, by the complement of the revised average credibility. This produces a factor by which the rates on risks producing an annual premium of $500 or more, must be reduced (in conjunction with the reduction for the expected off-balance of the Experience Rating Plan) to equalize the loss ratios of risks of this size with the loss ratios for risks with annual premiums of less than $500, when loss constants are collected on the latter type of risks.

(i) We now determine the expected credit off-balance of the Experience Rating Plan under the revised rates (b_2). This is determined by Formula III as shown in Appendix A, and is arrived at by deducting from the revised average credibility, the product of the ratio of the old offsetting adjustments in the July 1, 1938 rates and the adopted offsetting adjustments in the revised July 1, 1939 rates, and the excess of the revised average credibility over the revised off-balance. The complement of the expected credit off-balance produces a factor which measures the ratio of the premium which will actually be produced by the operation of the Experience Rating Plan to that which would be produced if the Plan achieved an exact balance.

(j) We then proceed with the calculation of the indicated loss constants by applying the offsetting adjustment for the revised July 1, 1939 rates to the full premiums for risks under $500, as shown in Exhibit 5, adding the amount of the resulting premium adjustment to the previously determined premium deficiency, and dividing the sum by the total number of risks under $500 for each industry group. The result is the indicated loss constant.

(k) We must then test the indicated loss constant to determine whether or not it contains a provision of at least $5.00 for administration and payroll audit expenses plus the loading for acquisition and taxes on the premium produced by the provision for these expenses. This is done by comparing 11½% of the indicated constant with a flat item of $5.00, and adding the excess, if any, of the $5.00 item to the indicated loss constant. This, in effect, merely guarantees that the adopted loss and expense constant will include at least $5.00 to cover the expenses of Home Office administration and payroll audit plus the loading for acquisition and taxes thereon. The indicated constants are then rounded to the nearest dollar.

(l) We now determine the premium realized from the constants by multiplying the rounded loss and expense constants by the number of risks subject thereto. The additional premium produced by the minimum expense constant of $5.00 and the rounding off of the constants is determined by subtracting the required premium from the premium actually realized. The total premium to be realized from rates less the excess premium over that required from loss constants, is then determined by multiplying premiums at full proposed rates for risks of $500 and over, by the offsetting adjustment and by the final modification due to the off-balance of the Experience Rating Plan, adding thereto the full premium on risks under $500 as reduced by the offsetting adjustment factor and then subtracting the excess premium due to the $5.00 expense constant and the rounding of the loss and expense constant. The provision for losses is determined by using 60% of the above figure after the additional premium from the $5.00 expense constant and rounding has been added back. The division of the losses so determined by the premiums, indicates the permissible loss ratio, which is .606 and which has been rounded to .605.

(m) A comparison of the New York expense loading with the general permissible (.60 ÷ .605) indicates a factor of .9917

to translate from the 60% loss ratio level to the 60.5% loss ratio level.

(n) It is then necessary to test the calculations to ascertain that the loss ratios of the two premium size groups within each industry group have been properly equalized by the loss and expense constants and the offsetting reductions when combined with the expected off-balance of the Experience Rating Plan. This we do by combining the premium for risks under $500 as reduced by the offsetting adjustment, times the factor of .9917 to adjust to the loss ratio level of 60.5%, with the premium realized from loss and expense constants, and dividing this premium into the losses for such risks. We similarly determine the premium for risks over $500 by taking the full premium at proposed rates and multiplying in the offsetting reductions, the Experience Rating Plan modification, and the factor of .9917 for the expense loading adjustment, and compare these premiums with the losses of the risks involved. The test indicates for all groups, an adjusted loss ratio of 58.7% for risks under $500, a corresponding loss ratio of 60.5% for risks over $500, and a total for all risks of 59.9%. It will thus be seen that the loss and expense constants and the offsetting reductions have practically equalized the loss ratios of the two premium size groups in the aggregate. In considering the loss ratio differential remaining between the two size groups, as indicated by the above test, it must be remembered that the expense constant has the effect of depressing the loss ratio on small risks to some extent.

We have now determined both the aggregate rate level changes and the adjustments necessary to apportion this rate level change equitably between experience rated risks and non-experience rated risks. We must now determine the multipliers to be applied to the selected pure premiums to translate them into terms of final manual rates. This is accomplished by the following steps:

The National Council's test of the *selected* pure premiums, as described in Part II, produces the following ratios to the pure premiums underlying existing rates:

Manufacturing	.924
Contracting	.919
Federal	.947
Servants Per Capita	1.019
All Other	.911
Total	.919

However, the above figures exclude the factor of 1.012, which should be included in the rates to provide for the payments to the stock and mutual security funds. We, therefore, divide the foregoing figures by the factor of 1.012, arriving at the following results:

Manufacturing	.913
Contracting	.908
Federal	.936
Servants Per Capita	1.007
All Other	.900
Total	.908

The index of the new collectible rate level, which is .925, divided by the index of .908, indicated from the adjusted National Council test, produces a factor of 1.019 to adjust the selected pure premiums to the adopted rate level. The indicated change in the collectible rate level is determined by multiplying the foregoing factor (1.019) by the National Council test figures adjusted for the security fund loading. This produces the following results:

Manufacturing	.930
Contracting	.925
Federal	.954
Servants Per Capita	1.026
All Other	.917
Total	.925

The indicated change in the printed manual rate level is determined by multiplying the indicated change in the collectible rate level, as given above, by the new offsetting adjustment factors for loss constants and dividing the product by the old offsetting adjustment factors for loss constants. This produces the following indicated change in the printed manual rate level:

Manufacturing	.901
Contracting	.954
Federal	.954
Servants Per Capita	1.026
All Other	.927
Total	.927

The pure premium multipliers are determined by applying the factor of 1.019 to the offsetting adjustment factors con-

tained in the new rates. This produces the following pure premium multipliers:

Manufacturing	.972
Contracting	1.046
Federal	1.019
Servants Per Capita	1.019
All Other	.976
Total	—

However, the enactment of Chapter 512, Laws of 1939, reducing the rate of interest discount to be used in determining the value of cases compensated on the basis of life pensions from 3½% to 3%, causes an increase in loss cost of .7% over all. However, the law amendment factor, by the direction of the Actuarial Committee, is calculated so that it will apply to serious pure premiums only. The effect on serious pure premiums is found to be 2.4%. Therefore, the multipliers quoted above, are used for non-serious and medical pure premiums and the following multipliers are used for serious pure premiums only:

Manufacturing	.995
Contracting	1.071
Federal	1.043
Servants Per Capita	1.043
All Other	.999
Total	—

The following is the formula for translating selected pure premiums directly into terms of final rates:

$$\frac{\text{Selected P.P.'s} \times \text{Final P.P. Multipliers}}{.605} + \$.01 \text{ Catastrophe Loading} + 1\% \text{ General* O.D. Loading} = \text{Final Rate}$$

Appendix B, attached, shows the calculation of the rate for Class No. 2501—Clothing Manufacturing—starting with the actual experience as reported to the Compensation Insurance Rating Board, and ending with the final printed manual rate, and also contains two suggestions for refinements in the ratemaking procedure which the writer feels may result in more accurate rates.

The reader will note references in this paper to various exhibits, memoranda, and calculations forming parts of the 1939 Revision. These may be referred to by those interested, in the offices of the Compensation Insurance Rating Board. They are not reproduced here because of their voluminous character.

*Limited to not less than $.01 and not more than $.05.

APPENDIX A

Part 1

CALCULATION OF LOSS CONSTANTS AND OFFSETTING ADJUSTMENT FACTORS — CAHILL'S FORMULAE

(1.05 Factor Retained in Loss Modification Factors of Experience Rating Plan)

SYMBOLS:

Z = average credibility ($Z = R\,Z_n + (1 - R)\,Z_e$. See formulæ for change in Medical Excess Ratio).

A = actual losses · 1.05 on Experience Rated Risks. (July 1, 1938 to 1939).

E = expected losses on Experience Rated Risks (July 1, 1938 to 1939).

b = actual credit off-balance (July 1, 1938 to 1939).

a = offsetting adjustment factor in July 1, 1938 Manual rates.

E_1 = E adjusted to eliminate effect of a.

b_1 = b adjusted to eliminate effect of a.

a_2 = offsetting adjustment factor in revised rates (July 1, 1939).

E_2 = E_1 adjusted to include effect of a_2.

P_2 = full premium at proposed rates for risks over \$500.

Exc. = excess premium produced for risks over \$500.

$1 - e$ = excess ratio (ratio of excess premium produced for risks over \$500 to full premium at proposed rates for risks over \$500).

b_2 = expected credit off-balance of Experience Rating Plan for revised (July 1, 1939) rates.

$$b = Z\left(1 - \frac{A}{E}\right) = Z - Z\,\frac{A}{E}$$

$$Z - b = Z\,\frac{A}{E}$$

$$E_1 = \frac{E}{a}$$

$$b_1 = Z\left(1 - \frac{A}{E_1}\right) = Z - Z\,\frac{A}{E_1} = Z - \left(Z\,\frac{A}{E}\right)\,a$$

$$\boxed{b_1 = Z - (Z - b)\, a}$$ FORMULA I

$$1 - e = \frac{\text{Exc.}}{P_2}$$

$$E_2 = E_1\, a_2 = \frac{E}{a}\, a^2 = E\, \frac{a^2}{a}$$

$$P_2 - \text{Exc.} = (P_2\, a_2)\left(1 - Z(1 - \frac{A}{E_2})\right) = P_2\, a_2 - P_2\, a_2\, Z + P_2\, a_2\, Z \frac{A}{E_2}$$

$$= P_2\, a_2\, (1-Z) + P_2\, a_2\, Z\, \frac{A}{E_2} = P_2\, a_2$$

$$(1-Z) + P_2\, a_2\, \frac{a}{a_2}\left(Z \frac{A}{E}\right)$$

$$P_2 - (P_2 - P_2\, e) = P_2\, a_2\, (1 - Z) + P_2\, a_2\, \frac{a}{a_2}\left(Z \frac{A}{E}\right)$$

Dividing by P_2

$$1 - (1-e) = a_2\, (1-Z) + a\, \left(Z \frac{A}{E}\right)$$

$$1 - (1-e) = a_2\, (1-Z) + (a)\, (Z-b) = a_2\, (1-Z) + Z - b_1$$

$$a_2\, (1-Z) = 1 - (1-e) - Z + b_1.$$

$$\boxed{a_2 = \frac{e - Z + b_1}{1 - Z}}$$ FORMULA II

$$b_2 = Z \left(1 - \frac{A}{E_2}\right) = Z - Z\, \frac{A}{E_2} = Z - \left(Z \frac{A}{E}\right) \frac{a}{a_2}$$

$$\boxed{b_2 = Z - (Z - b)\, \frac{a}{a_2}}$$ FORMULA III

APPENDIX A

Part 2

CAHILL'S FORMULA FOR EFFECT OF CHANGING MEDICAL EXCESS RATIO FROM .25 TO .35

SYMBOLS:

R = average normal ratio when medical excess ratio was .25.

D = change in average normal ratio when medical excess ratio is increased to .35.

subscript $_r$ designates revised value reflecting change in average normal ratio.

Other symbols used are the usual symbols employed in the Experience Rating Plan, as follows:

Z_n and Z_e = Normal and Excess Credibility Factors.

P = Total Unweighted Premium Subject to Experience Rating.

K_n and K_e = Normal and Excess Constants.

Also refer to symbols used in Appendix A, Part 1.

$$\text{Now } Z_n = \frac{P \cdot R}{P \cdot R + K_n} \text{ and } Z_e = \frac{P\,(1-R)}{P\,(1-R) + K_e}$$

$$\text{also } K_n = 1000 \cdot R\left(\frac{1350}{150 \cdot .605} - 1\right) \text{and } K_e = 1000\,(1-R)\left(\frac{5850}{50 \cdot .605} - 1\right)$$

As R (or $1 - R$) is a common factor to all terms of the Z_n (or Z_e) formulæ, any change in the value of R will not affect the values of Z_n and Z_e separately. However, the value of $Z = Z_n R + Z_e\,(1 - R)$ will be changed because of the increased weight given to Z_e and the decreased weight given to Z_n.

In the following formulæ, Z_n, Z_e, Z and Z_r are averages by industry group and are not specific values for individual risk sizes.

$$Z = Z_n R + Z_e\,(1-R)$$

$$Z_r = (R-D)\,Z_n + (1-R+D)\,Z_e$$

$$\therefore \boxed{Z_r = Z - D\,(Z_n - Z_e)}$$

$$\text{also } 1-b = \frac{A_n Z_n + E R(1-Z_n) + A_e Z_e + E(1-R)(1-Z_e)}{E}$$

$$\text{and } 1-b_r = \frac{A_n Z_n + E(R-D)(1-Z_n) + A_e Z_e + E(1-R+D)(1-Z_e)}{E}$$

$$b - b_r = \frac{E(R-D)(1-Z_n) - E R(1-Z_n) + E(1-R+D)(1-Z_e) - E(1-R)(1-Z_e)}{E}$$

$$= \frac{-E D (1-Z_n) + E D (1-Z_e)}{E} = -D(1-Z_n) + D(1-Z_e)$$

$$= -D + D Z_n + D - D Z_e = D(Z_n - Z_e)$$

$$b_r = b - D(Z_n - Z_e)$$

and $\boxed{b_r = b + Z_r - Z}$ or $Z_r - b_r = Z - b.$

The same reasoning applies for values of b_1 and b_{1r}.

Appendix B

Calculation of Manual Rate Effective July 1, 1939 for Classification No. 2501—Clothing Manufacturer

As an example of the employment of the ratemaking method described in the foregoing paper, the calculation of the rate for classification No. 2501—Clothing Manufacturing—is detailed below together with brief comments on an adjustment which it is believed should be made in the calculations to produce a truer and more equitable result.

The calculations are as follows:

Element	ACTUAL LOSSES AND PAYROLLS REPORTED BY CARRIERS									
	(1) P. Y. 1932 4th Report		(2) P. Y. 1933 4th Report		(3) P. Y. 1934 3rd Report		(4) P. Y. 1935 2nd Report		(5) P. Y. 1936 1st Report	
	No.	Amount	No.	Amount	No.	Amount	No.	Amount	No.	Amount
Death	4	28,465	3	34,842	9	58,395	8	63,707	5	25,572
Permanent Total	2	21,937	..	..	..	..	2	36,220	..	..
Major	19	66,919	15	69,522	23	83,159	19	62,544	21	68,175
Minor	224	107,370	256	95,285	328	123,567	369	165,271	458	193,910
Temporary	3,167	240,051	2,904	204,032	2,337	192,847	2,117	191,407	2,088	222,610
Unadjusted Medical*		339,771		354,163		363,554		391,314		422,471
Adjusted Medical**		355,558		367,585		380,093		409,260		441,209
Total Losses— Medical Unadjusted		804,513		757,844		821,522		910,463		932,738
Total Losses— Medical Adjusted		820,300		771,266		838,061		928,409		951,476
Payroll—Full Medical		119,999,239		178,043,332		214,466,523		229,093,637		269,531,098
Payroll—Ex-Medical		5,575,540		6,747,659		9,756,504		10,506,693		11,954,972
Payroll—Total		125,574,779		184,790,991		224,223,027		239,600,330		281,486,070

APPENDIX B — *Continued*

Element	AMENDMENT, DEVELOPMENT AND PROJECTION FACTORS									
	(6) 1932		(7) 1933		(8) 1934		(9) 1935		(10) 1936	
	Amend.	Proj.	Amend.	Proj.	Amend.	D. & P.	Amend.	D. & P.	Amend.	D. & P.
Death	1.009	.928	1.001	.984	1.000	1.043	1.000	1.055	1.000	1.072
Permanent Total	1.069	.928	1.088	.984	1.010	1.043	1.000	1.055	1.000	1.072
Major	1.050	.928	1.037	.984	1.035	1.043	1.005	1.055	1.000	1.072
Minor	1.051	.928	1.038	.984	1.035	1.043	1.005	1.055	1.000	1.072
Temporary	1.027	.928	1.027	.984	1.023	1.043	1.003	1.055	1.000	1.072
Unadjusted Medical	1.000	.902	1.000	.946	1.000	1.047	1.000	1.034	1.000	1.029
Adjusted Medical	1.000	.902	1.000	.946	1.000	1.047	1.000	1.034	1.000	1.029

APPENDIX B — *Continued*

Element	EXPERIENCE AS IN CLASSIFICATION EXPERIENCE EXHIBITS						
	(11) 1932 (1) × (6)	(12) 1933 (2) × (7)	(13) 1934 (3) × (8)	(14) 1935 (4) × (9)	(15) 1936 (5) × (10)	(16) 1932 - 1936 (11)+(12)+(13)+(14)+(15)	(17) Indicated Pure Premium
Death	26,653	34,319	60,906	67,211	27,413	216,502	
Permanent Total	21,763	..	..	38,212	..	59,975	
Major	65,206	70,940	89,771	66,314	73,084	365,315	
Total Serious	113,622	105,259	150,677	171,737	100,497	641,792	.06 (.061)
Minor	104,721	97,324	133,391	175,232	207,871	718,539	
Temporary	228,782	206,188	205,765	202,540	238,638	1,081,913	
Total Non-Serious	333,503	303,512	339,156	377,772	446,509	1,800,452	.17 (.171)
Unadjusted Medical*	306,473	335,038	380,641	404,619	434,723	1,861,494	.18 (.176)
Adjusted Medical**	320,713	347,735	397,957	423,175	454,004	1,943,584	.18 (.184)
Total Losses— Medical Unadjusted	753,598	743,809	870,474	954,128	981,729	4,303,738	.41 (.408)
Total Losses— Medical Adjusted	767,838	756,506	887,790	972,684	1,001,010	4,385,828	.. (.416)
Payroll Total	125,754,8—	184,791,0—	224,223,0—	239,600,3—	281,486,1—	1,055,675,2—	

APPENDIX B — *Continued*

	Serious	Non-Serious	Medical (Unadjusted)	Medical (Adjusted)	Total (Medical Unadjusted)	Total (Medical Adjusted)
(18) Selected Pure Premiums (Col. 17)..	.06 (.061)	.17 (.171)	.18 (.176)	.. (.184)	.41 (.408)	.. (.416)
(19) Multipliers to Final Collectible Level	.995	.972	.972	.972		
(20) Product (18) × (19).....	.060 (.061)	.165 (.166)	.175 (.171)	.. (.179)	.40 (.398)	(.406)
(21) Same Loaded for Expenses $\frac{(20)}{.605}$	.. ..	.. ..	.. ..	.. ..	.66 (.658)	(.671)
(22) Same plus Catastrophe Loading (21) + .01.....					.67 (.668)	(.681)
(23) Same plus General O. D. Loading (22) × 1.01 ***.....					.68 (.678)	(.691)
(24) Final Rate (Column 23 rounded)...					.68 (.68)	(.69)

* No adjustment was made by the National Council in the amount of the medical losses to allow for medical losses eliminated on Ex-Medical coverage. The Council makes such an adjustment only in classifications where the Ex-Medical payroll constitutes more than 10% of the total payroll.

** Suggested adjustment formula, used in this exhibit, is as follows: $\frac{\text{Unadjusted Medical}}{\text{Payroll Full Medical}}$. Payroll Total = Adjusted Medical.

*** General O. D. Loading is 1%, limited, however, to not less than .01 and not more than .05.

NOTE: Figures in parentheses are computed to three decimal places.

It will be noted that two figures have been shown under the caption "Indicated Pure Premium" for each of the pure premium divisions—serious, non-serious and medical. Also medical losses and pure premiums have been shown on two bases—unadjusted and adjusted and the total losses and pure premiums have been shown with medical unadjusted and with medical adjusted. The reasons for these extra figures are as follows:

(1) Part of the experience of classification No. 2501 is on an ex-medical basis, therefore, it follows that, if this experience is to be used in determining full coverage medical pure premiums, an adjustment should be made to project the medical losses to a full coverage basis. The National Council on Compensation Insurance, which calculates the pure premiums, does not make this adjustment except in those classifications in which the ex-medical exposure constitutes more than 10% of the total exposure. As the ex-medical exposure in this classification is somewhat less than 5% of the total, no adjustment has been made. However, this classification is an extremely important one in the State of New York, producing more than one billion dollars in payroll for the five year experience period. The medical losses have, therefore, been adjusted in accordance with the following formula and new medical pure premiums have been derived on the basis of such adjusted losses:

$$\frac{\text{Unadjusted Medical}}{\text{Payroll Full Medical}} \cdot \text{Payroll Total} = \text{Adjusted Medical}$$

While the adjustment does not produce any change in the final pure premium if each of the partial pure premiums (serious, non-serious and medical) is rounded to the nearest cent, the actual difference caused by the adjustment is $.008 on the medical pure premium. This will be further discussed in point (2) following.

(2) In calculating pure premiums for large self-rating classifications (such as the one under discussion) where the pure premiums are $.50 or less, it is submitted that such indicated pure premiums should be figured to the nearest tenth of a cent instead of to the nearest cent, as is the present practice. It will be observed from the pure premiums shown in parentheses in the "Indicated Pure Premium" column, that had the pure premiums for this classification been computed to the nearest tenth of a cent, and had the medical losses been adjusted as suggested, the final rate would have been $.69 instead of $.68. While at first glance,

> this may seem unimportant, it will be observed that, based on the payrolls of policy year 1936, an addition of 1¢ to the Clothing Manufacturing rate would have produced an additional premium of more than $28,000 for the insurance carriers of the state, and over the five year experience period, the additional premiums would have been in excess of $105,000. In view of the steadily increasing payroll of this classification as indicated by the experience, the loss in premium at the present time may be considerably greater than $28,000 per annum.

It is therefore suggested that pure premiums on low rated classes (classes developing a total indicated pure premium of $.50 or less) be computed to the nearest tenth of a cent rather than to the nearest cent. It may be that all classification pure premiums should be computed to the nearest tenth of a cent, but the combination of computing pure premiums to the nearest tenth of a cent in low rated classes, and adjusting ex-medical experience to a full coverage basis in all classes, should be productive of more accurate and more representative pure premiums.

After pure premiums have been selected, the multipliers to the final collectible rate level are applied to the partial pure premiums selected and the total of these items is loaded for expenses. A flat catastrophe loading of 1¢ is then added and to this total, is added the general occupational disease loading of 1% of such figure, limited, however, to not less than 1¢ and not more than 5¢. The result, rounded to two places, is the final classification rate.