ABSTRACT OF THE DISCUSSION OF THE PAPERS READ AT THE PREVIOUS MEETING.

SHOULD THE COMPENSATION PREMIUM REFLECT THE EXPERIENCE OF THE INDIVIDUAL RISK?—WINFIELD W. GREENE.

VOL. II, PAGE 347.

THE EXPERIENCE RATING OF WORKMEN'S COMPENSATION RISKS.—JOSEPH H. WOODWARD.

VOL. II, PAGE 356.

WRITTEN DISCUSSION.

MR. E. H. DOWNEY:

These papers raise four fundamental issues: (1) whether any form of experience rating is consonant with sound insurance theory; (2) whether (if the first question be answered in the affirmative) experience charges and credits should be graduated to size of risk as well as loss ratio; (3) whether the experience rate should be retrospective or prospective and (4) what statistics are requisite to test the several forms of experience rating already existing or proposed. Within the appropriate limits of a discussion it will not be possible to do more than summarize my own views upon these matters.

1. Since insurance is primarily a means of loss distribution, it has been argued with much cogency that the experience rating of individual risks is *ipso tanto* contrary to the fundamental purpose of insurance. It is well known that the bulk of compensation losses are incurred upon a comparatively small number of risks. In this fact, indeed, lies the *raison d'être* of insurance from the employer's standpoint. On the other hand, everyone recognizes that there is a wide variation of inherent hazard as between individual establishments in the same manual classification. Such variation apparently arises from three sources: (*a*) differences in plant and equipment, (*b*) differences in processes and products and (*c*) differences in *morale,* under which term are comprised shop organization and discipline, methods of work, safety instruction, and the permanence, intelligence and industrial training of the working force. Differences of the first order are graded by schedule rating, but it does not appear possible either to grade plant *morale* in this way or take account of the wide variety of products and processes covered by such a classification as machine shops. Hence there is very strong ground to believe that experience rating affords the best means at

present available both for the adjustment of rates to certain very important hazards and for the stimulation of preventive measures as respects accident causes not covered by the rating schedules. This argument applies with special force to those businesses not subject to schedule rating.

It appears to me possible to reconcile these conflicting views by excluding deaths from experience rating and by limiting the effect of other costly accidents. An employer who has paid his premium for the very purpose of avoiding risk may properly object to being saddled to the extent of several thousand dollars with the cost of a death or a permanent disability—as may well happen under the New York, the Massachusetts, or the Service Bureau's experience rating plans. Why insure at all if he is compelled to carry his own risk on that very class of rare and costly accidents the burden of which ought in all conscience to be distributed over the industry at large? Deaths and permanent total disabilities, just because of their comparative rarity, are the least calculable and the least preventable of accidental injuries. The occurrence of a fatality or a permanent total disability in a given establishment proves nothing as to its inherent hazard and a penalty therefor effects nothing in the way of accident prevention. Yet all the experience rating plans above referred to do compel the employer to carry his own risk, in substantial measure, upon these very accidents. Indeed, as these plans are worked out, the premium increase in a given case may even exceed the actual cost of the accident in question. Therein these plans seem to me clearly inequitable and clearly opposed to all sound principles of compensation insurance.

It is perfectly possible, however, to formulate an experience rating plan (as has been done by the Actuarial Committee of the Pennsylvania Rating Bureau) which is based upon deviations from the normal loss ratio on account of ordinary accidents. Such a plan appears to me to preserve all the advantages which can be claimed for any form of experience rating at the same time that it does no violence to the essential principle of loss distribution.

Mr. Greene has mentioned another objection to all forms of experience rating—that they give the assured a direct interest in short changing the workman. I believe that this difficulty, like all others connected with the actual payment of benefits, can be overcome by proper administration of the compensation law.

2. Mr. Woodward's arguments in favor of excluding small risks and of graduating credits and debits to size of premium appear conclusive. It is to be observed, however, that the exclusion of deaths and the partial exclusion of permanent disabilities will greatly narrow that chance deviation which Mr. Woodward rightly emphasizes in connection with smaller risks. As Mr. Ryan has long since pointed out, the size of risk which may properly be experience rated is very much reduced under a plan limited to ordinary accidents. On the other hand, it appears very doubtful

whether any form of experience rating will make insurance attractive to an employer whose exposure is broad enough to give a dependable pure premium. No carrier can hope to serve such an employer as cheaply as he can serve himself. He has no motive to insure unless it be against catastrophe—and experience rating is surely not applicable to catastrophes.

3. Against retrospective experience rating it is urged that premium increases will not be collectible after the policy has expired and that the scheme introduces a participating element whereby the employer is unable to determine in advance the cost of his insurance. With regard to the first of these objections, it is to be observed that most policies are issued for a deposit premium materially less than the amount earned during the policy period. If, then, the policy contains a definite agreement for experience rating and if the experience adjustment is made a part of the final settlement after audit, there would seem to be no special difficulty about collecting such increases as may fall due. Neither am I able to see that the participating element would be particularly obnoxious to employers. Insurance is a small item in entrepreneur's cost as contrasted with labor, materials, transportation and advertisement, all of which are subject to wide and sudden fluctuations. Besides, the popularity of the mutual principle in all forms of insurance goes far to answer this particular criticism. To offset these objections, retrospective rating has very great advantages. It offers the best possible incentive to accident prevention, for it starts each policy year with a clean slate and makes that year's rate to depend upon the experience actually realized therein. Accidents cannot be prevented in the past. It is the reverse of encouraging to tell the employer that last year's bad experience will nullify his good record for years to come. Furthermore, accident experience, whether as a whole or in any particular establishment, fluctuates with recurrent cycles of depression and prosperity. A cumulative prospective plan, accordingly, will yield premium decreases in a boom year following upon a period of depression and premium increases in a dull year following flush times—which is to say that such a plan will decrease premium income when losses are abnormally high and increase it when losses are abnormally low. A retrospective plan, on the contrary, will always reflect current experience, thereby introducing a much needed element of elasticity into premium income. By the same token, a retrospective plan will secure a balance of increases and decreases—something which can never be attained by prospective rating. Lastly, the retrospective plan is much less susceptible of manipulation for the purpose of controlling renewals.

4. Every student of experience rating has been embarrassed by the total want of statistics which could serve to throw any light upon the subject. We know next to nothing of loss distribution by individual risks, or by size of risks, or by nature of injury.

Whence it is impossible to prognosticate either the aggregate premium results or the frequency distribution of premium increases and decreases under any experience rating plan. The existing plans of New York, Massachusetts, and the National Workmen's Compensation Service Bureau were frankly formulated in the dark. The Pennsylvania committee adopted an ingenious device whereby the credits will be determined by, and will be equal to, the developed charges, but there is no pretense that the amount of either can be predicted. Evidently nothing but detailed analysis of individual risk experience will furnish the necessary information. It is not enough to know whether the charges and credits approximately balance: the number of employers penalized in stated amounts and the character of accidents which develop these penalties are essential elements in the fairness and expediency of any particular experience rating plan. To render this sort of information available for one state, at least, Special Pennsylvania Schedule ZZ was devised.

Summing up: it seems to me that the advantages of experience rating, under certain restrictions, will much outweigh its disadvantages. In accordance with the foregoing arguments, the plan should be based upon the actual loss ratio from ordinary accidents only, should exclude risks below a certain minimum size, should provide maximum charges and credits graded to size of manual premium, should be retrospective in application, and should be founded upon and continually tested by detailed analysis of individual risk experience.

MR. C. W. FELLOWS:

To attempt a discussion of Mr. Greene's paper may leave me open to the charge of holding to a biased opinion; nevertheless, I have seriously attempted to maintain an unprejudiced view, though early convictions have not been shattered by other honest viewpoints which have been given publicity in the *Proceedings* of the Society, and in which a wide variance in views of this subject has been displayed.

Experience Rating.

In addition to agreeing with Mr. Greene's well-founded objections to the principle of experience rating, there appear to be other arguments to be used against the plan which may or may not have been forcibly brought out heretofore in one form or another. It seems essential to first look for the source from which this theory of experience rating emanated.

Is the idea born of some altruistic motive and is it a conscientious effort to improve upon heretofore accepted theories and practices in rating risks for various forms of insurance?

Is it an attempt to discourage the larger risks from a growing tendency towards self-insurance?

Or is it, as I am inclined to believe, a theory founded upon a realization that Mr. Rubinow is right and that "insurance being in its essence an arrangement for mutual protection, the gradual extension of the mutual principle is inevitable"; and, therefore, in order to escape the necessity of issuing true participating insurance on compensation risks, some substitute must be offered to meet the growing demand?

It seems that too little has been said of the very apparent discrimination and consequent injustice to the small employer which must necessarily follow the application of an experience rating plan to only those risks which are, admittedly, of sufficient proportions to represent a pay-roll exposure from which can be derived some fair idea of the expected pure premium. What argument can be presented to justify another procedure with the small employer? If his risk happens to present a better moral hazard than others of the same classification is there any acceptable reason to give him for failure to find a plan to measure that lesser hazard in his case.

As a practical matter we must not lose sight of the bearing the general adoption of experience rating is bound to have upon the expense of conducting the business, and if it is expected that large employers are to be encouraged to insure, a further consistent effort to reduce the expense loading should accomplish much more than any elaborate system for individual rating of risks. The application of any experience rating plan must necessarily add to the cost of administration and it should be kept in mind that the present heavy expense loading is the target at which the insurance critic persistently strikes, and is the most effective weapon of state funds in competition with corporate carriers.

If credence is to be given to the opinion of most underwriters that ten risks with a premium of $100 each will consistently produce more profit than one risk carrying a premium of $1,000; if it is admitted that the moral hazard varies in small risks as in large ones; and if we admit that the so-called moral hazard cannot be measured in the case of the small risk, where can experience rating lead us except into the unfailing light of public opinion, which will inevitably ferret out our fallacies and inconsistencies and hold us up to ridicule?

Admitting for a moment that experience rating is a needed panacea for the ills of the business, could an experience of the past be a fair indication of the future moral hazard in times such as these, when feverish activity is being manifested in our large industries and the driving of the human machine to the limit has in so many cases replaced a previous safe and sane plant organization, or at any other time in our versatile and everchanging industrial habits and devices?

A Possible Alternative for Experience Rating.

As the handling of any commodity in wholesale quantities will permit of closer buying and selling, likewise we might advance the theory that some encouragement could be reasonably offered the larger employer to insure by *grading the expense loading of the rate in his case by the amount of pay-roll exposure or the total premium* represented in his risk.

It must be conceded that it costs no more to actually write a policy on a large risk than on a small one, likewise little, if any more, to keep the necessary office records of the risk (this would not apply so literally to claim, inspection or auditing expense). In some states commissions to brokers and agents are graded according to the size of the premium and it seems consistent that this item of saving in acquisition cost, as well as some of the other detail office administration expense, might reasonably be reflected in an individual rating. This without departure from the principle referred to by Mr. Greene "that the assured shall pay a premium commensurate with the *a priori* probability of loss"; and without the practical difficulties and added expense of applying any experience rating plan yet proposed.

The adoption of such a plan for individual rating would necessitate some new statistical and actuarial formulæ to be used in the promulgation of basic rates, but this would seem to present less difficulty than the necessity of providing in advance for the fluctuations due to experience rating. Such a plan would not present such an element of discrimination and could be more readily justified with the employer who is a buyer of insurance in smaller "quantity."

I do not know whether or not this theory has ever been previously advanced and it is quite possible that it will be open to many criticisms, but it seems to me that the crude thought herein outlined may be subject to potential development and, in any event, is free from many of the just criticisms to which individual rating based upon frequency or severity of accidents is subject.

Feasibility of a Deductible Average Plan.

As in the case of experience rating, it appears that little, if any, consideration has been given to the fact that the deductible average plan of reflecting the individual risk experience in the premium offers a serious obstruction to any hope of reducing expense loading in rate making, and this should be of paramount interest in the consideration of any new rating plan contemplated. This objection should also seriously engage the attention of state insurance departments which are presumed to be essentially interested in the public weal.

One of the greatest attractions which the principle of insurance holds for insurers is the guarantee that through it the employer's

maximum compensation costs are fixed, and that no matter how serious the losses may prove to be, he cannot be called upon to pay more than the rate established at the inception of the insurance coverage. Therefore, any deductible average plan which contemplates uncertain added costs dependent upon experience throughout the policy term would not, in my opinion, prove of particular interest to insurers and would absolutely fail of any purpose it might have to encourage insurance in large establishments.

These objections would not apply to deductible average insurance in the usual acceptance of the term as applied to casualty risks, but the dangers in the general adoption of that plan have been well summed up by Mr. Greene. He points out the possibility of employers bringing undue pressure upon employees to prevent claims, and that this danger has passed the conjectural stage is indicated by some experience we have had under participating policies, where employers have gone so far as to attempt to influence the attitude of their carrier toward certain claims in order to produce a more favorable experience to be considered in dividend disbursements based partially upon individual risk loss ratio. Usually these interferences have been backed by honest intent, although with judgment warped by personal interest and lack of the proper appreciation of the spirit of the law. Such instances have been comparatively few, but might readily increase in number if not only the dividend but the initial cost of compensation is seriously affected by individual risk experience.

This points clearly to the conclusion that the principle of deductible average, when considered in connection with compensation risks, is clearly not in keeping with the broad spirit of less selfish human intercourse and of general social betterment in industry which compensation statutes are designed to advance.

Retroactive Experience Rating of All Large Risks.

This plan, which is also most ably dissected by Mr. Greene, seems to most nearly approach the true principle of participating insurance when first considered, but a closer study of its intent and underlying principle reveals that it is open to all of the objections offered to the other two plans herein considered save one:

It is an improvement over the usual experience rating plan in that it does not attempt to measure future accident frequency or moral hazard by past experience. It does, however, offer the same objections as to the practical difficulties of application; possibility of competitive abuses; a serious stumbling block to decreased expense loading; and the unjustifiable discrimination against small employers.

It is presumed a provision would be made in the formula used in basic rate promulgation to counteract the effect of this plan upon premium income, and there is nothing to indicate that its adoption

for use by corporate companies would work for the purpose of returning to insurers that portion of the premium which represents the excess over losses, expenses and reasonable profit to the insurance carrier; nor for the purpose of fairly compensating for any relative inconsistencies in initial basic rates so long as it must needs leave the small employer outside the scope of its application.

MR. LEON S. SENIOR:

In his paper, Mr. Woodward has established two important definitions as a useful guide in the discussion of the theory of rate making on the basis of individual risk experience; I refer to the terms of "hazard deviation" and "chance deviation."

The average pure premium for a given classification reflects the loss expectancy for that classification. The experience on single risks will, of course, show a departure from the average pure premium. This departure is analyzed by Mr. Woodward and separated into two parts. The first is described as the "hazard deviation" and is due largely to error caused by imperfect rate-making judgment, incomplete statistics, improper classifications and fluctuating industrial conditions. The second is defined as the "chance deviation" for the reason that the departure of the actual experience of the risk from the average pure premium is due to the element of chance. Our brethren in the legal profession would probably describe "hazard deviation" as due to the "act of man" and "chance deviation" as due to the "act of God."

The author of the definitions proceeds to bring out with remarkable clarity the qualities of the two variations and establishes the principle that the hazard deviation becomes increasingly important with the increase in the size of the risk, the size being measured by volume of payroll exposed or, preferably, by amount of premium.

Analysis of the New York Experience Rating Plan.

In analyzing the New York experience rating plan it will be of interest to show the extent to which the doctrine of "hazard deviation" influenced the provisions of such plan. In determining the qualifications of risks subject to experience rating, recognition was given to the fact that in small risks the departure of the experience from the loss expectancy is due entirely to chance and not to hazard deviation. Experience rating as a method of correcting the human error in rate making is not applicable to small risks. But where is the boundary line to be drawn between small and large risks and what shall be the measure? If the payroll exposure is applied as a measure, the effect will be to bring within the operation of the plan, risks in the low-rated classifications, sufficiently large from the standpoint of the number of lives exposed but too small as measured from the standpoint of pure premium or loss expectancy. The

use of the premium test as a measure of size, on the other hand, is open to the objection that in the high-rated classifications certain risks will become eligible for experience rating on account of the high premium, although showing a low exposure measured by the number of lives at risk.

As a result of these considerations it was determined to adopt, as a measure of size, a test including both payroll and premium. The minimum limits which have been adopted—$100,000 payroll for *manufacturing risks*, $50,000 payroll for *contracting* and public service risks and $500 premium for all risks covering a two-year period—are, of course, based upon judgment and are presumed to represent on the average one hundred lives exposed to the risk of industrial accidents.

In the valuation of the experience we are confronted with the question as to whether the actual experience of the risk shall be used to determine the experience modification, or whether the experience is to be valued on an average table derived from the analysis of the total losses incurred in a given jurisdiction.

The problem is further complicated by other inquiries pertinent to the subject. To mention a few:

1. Shall each accident be valued on an average basis regardless of type?

2. How shall medical cost be valued?

3. What distinction shall be drawn between notices of injury, tabulatable accidents and compensatable accidents?

The valuation of experience upon the basis of losses paid and incurred is open to the objection that the method requires the estimation of losses on pending claims not settled and in process of adjustment, which, under the best conditions, produce uncertain and indefinite results.

But, aside from this objection, if experience rating is designed to correct the error due to hazard deviation and to provide an individual appraisement of the risk consistent with the accident frequency, valuation of losses upon an average basis is logical and in accord with the doctrine of hazard deviation. I am inclined to view rate modification based upon the actual experience of the risk as an attempt to correct the chance rather than the hazard deviation.

There may be merit in the theory that the *morale* of the risk may best be measured by a system which will provide uniform charges for each accident, regardless of its type. In practice, however, such a system will produce unsatisfactory results.

In his criticism of the deductible average plan, Mr. Greene brings out the fact that in order to pay current losses, set aside sufficient reserves and meet expenses, $486 must be collected for each accident compensated in accordance with the provisions of the New York law.

An experience rating plan, therefore, providing a uniform charge for each type of accident will require, approximately, a charge of $100 in order to justify the maximum 20 per cent. reduction in premium. As in the majority of cases submitted for rating the prevalent type of accident is one which falls within the class of temporary disability, the cost for which varies between $40 and $120, a uniform charge of $100 will so distort the individual experience of the risk as to practically nullify the effort to correct the error described as hazard deviation.

The New York plan provides a table of valuation based upon average experience results. The injuries are divided into

(1) Resulting in fatal,

(2) Permanent disability,

(3) Dismemberments (further subdivided as to character in accordance with the provisions of the law),

(4) All other compensatable accidents.

It is to be noted that the term "tabulatable accident" has been discontinued; charges are provided only for compensatable accidents, which are defined as those accidents entitling the injured or his dependents to compensation under the act. The question of providing values to represent medical cost has been solved by requiring that each notice of injury shall be charged at the rate of $12 per notice, this amount representing approximately, the average cost per notice as shown by the experience of the New York State Insurance Fund. This method has been subjected to criticism on the ground that employers do not uniformly report notices and on the further ground that the medical cost varies with the experience of each company. Possibly the best solution for the valuation of medical cost is to provide a charge based upon the actual incurred loss in each case. This method, however, is again open to the objection that it involves estimates for unpaid items which must be a matter of judgment. On the whole the latter method would seem to be preferable.

The experience of the past, when applied to modify rates on future policies, is defined as the prospective method. This method has been adopted as part of the New York plan. The present experience on current policies applied to modify the premium after the expiration of the policy is defined as the retrospective method. The retrospective method possesses elements resembling the mutual practice of returning dividends and making assessments. This resemblance to the mutual practice and the practical difficulty involved in the collection of additional charges after the expiration of the contract were the deciding factors in favor of the prospective idea.

Reverting again to the theory of hazard deviation, the prospective plan seems to be more appropriate for the correction of the error due to imperfect rate-making. The pure premium for the entire

classification is determined from past experience. The correction of the pure premium for the individual risk should, therefore, also be based upon the past individual experience of the risk.

The New York plan gives full recognition to the principle that the hazard deviation grows more important with the increase in the size of the risk. The application of this theory has resulted in the adoption of a schedule of debits and credits, subject to maximum limits, depending upon the volume of earned premium. Beginning with a premium of $500, the risk is subject to a maximum debit or credit of 5 per cent., up to the point where the earned premium amounts to $5,000, in which case the maximum debit or credit is equal to 20 per cent. Between those two points the debits and credits are interpolated so as to provide an increase of 1 per cent. for each $300 of earned premium.

The actual debits and credits allowed vary in proportion to the loss ratio. The loss ratio is developed in the following manner: The sum representing the valuation of losses, according to the standard table, divided by the total payroll produces the theoretical pure premium. This pure premium is divided by the manual rate and the quotient represents the loss ratio of the risk.

A neutral zone has been established for cases which produce a loss ratio from 40 per cent. to 65 per cent. For a loss ratio equal to zero, the maximum credit is allowed; with the increase of the loss ratio, the credit is reduced in proportion. For a loss ratio equal to 100 per cent., the maximum debit is imposed; with the decrease of the loss ratio, the debit decreases in proportion.

The full application of the hazard deviation theory would justify, as suggested by Mr. Woodward, a variable neutral zone, decreasing in width in proportion to the increase in premium. Under the New York plan, however, the neutral zone is constant and is in this respect, therefore, a departure from the general principle.

The foregoing review would seem to justify the conclusion that the New York Experience Rating Plan is based upon a sound theory. Experience rating in general, and this plan in particular, is in an experimental stage. It will, therefore, be worth while to observe the results closely. A comparatively short period of time will suffice to indicate whether the present plan will meet with favor and whether it will achieve the results looked for. Whatever such results will be, I do not for a moment believe that experience rating will at any time supplant the system of schedule rating. As an auxiliary to such system, for the purpose of characterizing the *morale* of the risk and correcting the error due to hazard deviation, it may eventually become of real value, provided its application is confined to a class of risks justly entitled to individual treatment.

MR. G. F. MICHELBACHER:

As a clear-cut statement of the theory of experience rating Mr. Woodward's paper is highly commendable. In it he discusses the more important phases of the rating problem and makes certain recommendations, all but one of which have been found so valuable that they have been incorporated in the two most recent plans, the New York plan and the plan of the National Workmen's Compensation Service Bureau. This fact in itself shows conclusively that the theory of the paper is sound and furthermore, that Mr. Woodward's conclusions are the conclusions of the men who most recently have been engaged in the study of this problem. It is difficult under these circumstances to take issue with Mr. Woodward's arguments in general. I should like, however, to take up and discuss one or two points upon which I do not agree with Mr. Woodward.

In the first place, I cannot agree that Mr. Woodward has enumerated all the reasons for experience rating. I cannot agree that he has named the principal reasons at all. In my opinion, it is not one of the primary objects of an experience rating plan to provide "a cheap and easy means of encouraging organization for safety and the guarding of machinery." To be sure, because experience rating is one method of individual or merit rating it indirectly tends to promote industrial safety. It should be pointed out, however, that an experience debit or credit is not so constructed that it can be analyzed by causes of accidents. There is no way in which an assured can directly reduce his experience rate by the installation of safety appliances or the organization of a safety campaign. The incentive is there in a general way, but no experience rating plan contemplates a specific enumeration of accident hazards, with values for their modification or elimination. All this belongs to schedule rating, for after all the encouragement of safety work depends upon the observation and valuation of those hazards which are physically in evidence—the large number of danger points to which the attention of the assured can be directed and for which definite values can be determined, based upon their contribution to the total hazard of the risk and also, in considerable measure, upon the cost of eliminating them or minimizing their effect. Each item in any schedule represents a number of potential accidents and each item should be so evaluated that it will place before the assured a definite proposition in that by considering the premium charge for the item on the one hand and the cost of the elimination of the hazard on the other he can readily decide whether it will be to his advantage to install safeguards. The strength of any schedule for prevention lies in its ability to put questions of this character before employers in a concrete, understandable way. I should say that the rôle of experience rating, in connection with the rating of manufacturing risks, is to play second fiddle to the schedule rating plan.

The primary object of experience rating, to my notion, is not to measure physical hazards, but to check the schedule which does measure them and incidentally to feel the moral pulse of the risk. Schedule rating deals with moral hazards to some extent, but its application for this purpose is limited to the consideration of physical evidences of moral hazard. A risk may be well lighted and well ventilated; it may be provided with proper sanitation; and it may have in evidence safety bulletin boards and safety committees. All these factors which have some bearing on the moral hazard can be discovered by examination—they are physically in evidence. But they do not of themselves determine whether the moral hazard of the risk is good or bad. The worst plant physically may constitute the best risk morally, or vice versa. We have all heard of manufacturing plants which according to physical conditions should produce a great number of accidents, but which because of the character of the employees produce comparatively few accidents. On the other hand, it has been the experience of some insurance carriers that the physically best plant sometimes produces more accidents than an inferior risk in the same classification, though theoretically it should produce fewer accidents. All of which goes to show that the physical evidence of the moral hazard is not conclusive and that the true measurement of the intangible factors which constitute this hazard must contemplate some other method of valuation.

If it were possible physically to examine each and every employee, to chart his individual characteristics, his nervous system, his brain, his habits and to reduce the hazard of management to a formula, we might truly schedule rate the moral hazard. But this plan is not feasible and so we are forced to accept the only available practical method of measurement—the valuation of the capacity of the individual risk to produce accidents. We may allow an employer a 10 per cent. reduction in his rate for the organization of a safety campaign and he may engage to erect bulletin boards, to distribute safety literature, to hold safety conferences with his employees, to engage a competent safety inspector and to appoint safety committees from the ranks of his workers. All these reforms have physical aspects which can be observed, but we cannot directly observe the effect of such measures upon the minds and habits of the workers. We know in general that such methods are desirable, that they tend to reduce accidents and we can allow an average credit to all employers who recognize and use them. But we also know that their effect varies greatly from plant to plant and under different conditions. Experience rating measures the true effect of methods of this character by a valuation of the degree to which they decrease the accident frequency.

This is true, also, of other items in a schedule, which do not directly involve the moral hazard. It is true, for example, in connection with the guarding of machinery. The fact that a guard,

which can be observed by an inspector, has been installed, does not necessarily prove that the guard will be 100 per cent. effective in the prevention of accidents. As a matter of fact, it has been stated that the installation of a safeguard is only 50 per cent. efficient in preventing accidents. In such cases the experience rating plan again proves the schedule and measures the actual effect of the item on the accident frequency of the risk.

I should say, therefore, that for risks which are subject to schedule rating, the fundamental reason for experience rating is the necessity for a method of proving the various items in the schedule, particularly those items which measure the so-called moral hazard.

For risks which are not subject to schedule rating, the reason for experience rating is more pronounced. The majority of such risks involve contracting operations where there is no fixed plant which can be physically rated. Experience rating is, therefore, the only available method of individual rating for risks of this character. If it is admitted that merit rating is desirable, then there certainly exists a very good reason for the experience rating of these risks, as this is the only method of merit rating yet devised, which can practically be applied to risks which cannot be individually rated by schedule.

A second point of difference between Mr. Woodward and myself involves the question of prospective versus retrospective rating. Mr. Woodward has attempted fairly to state both sides of this question, but, even so, it strikes me that he is decidedly in favor of the retrospective method. Personally, I know of no experience rating plan which has attempted to apply this method to the rating of compensation risks. The reason for this is obvious. The general rule is that, to be effective, merit rates must be available to the agent when he solicits the business. This is particularly true of rates produced by the application of a plan which may either increase or decrease manual rates. The Bureau plan for this reason requires the computation of experience rates prior to the date of expiration of the current policy and definitely prohibits the promulgation of rates which may be made retroactive within a policy period. In this way the prospective policy holder is informed in advance of the rates at which his risk will be written and the application of debits as well as credits is not only simplified but is also assured. I should like to emphasize Mr. Woodward's statement that this practical reason is the best argument in favor of the prospective method, particularly if the plan provides for debits and credits. If the plan provides for credits only, there can be no argument against the retrospective method. But the fact that the manual contains average rates, which measure the cost of accidents for the average risk in the classification, renders it impossible at the present time to produce a workable plan based entirely upon credits.

Furthermore, are Mr. Woodward's objections to the prospective

method very important? It is difficult to discover how the fact of varying payroll expenditure has any bearing on this question if the plan of experience rating is properly constructed. In the application of the Bureau plan the accident data and the payroll expenditure are reported for the same experience period. The data are valued and are then compared with an average rate computed upon the basis of the payroll exposure for each classification for the experience period and upon present manual rates (not the rates for the experience period). The experience modification so determined is in turn used to modify the present manual rates for the classifications in which the risk is to be written. As long as the experience data and the payroll exposure are taken for the same experience period, I fail to see where there can be discrimination on the score of varying payroll exposure. Then Mr. Woodward makes a point of the fact that the prospective method in the case of renewals requires an insurance carrier to use the experience which former insurance carriers have accumulated for the risk. This would also be true in equal measure of the retrospective method, unless one year were made the maximum experience period. As far as I know, the experience with systems which involve this feature has been satisfactory in every respect. Finally Mr. Woodward states that "A serious disadvantage in the use of the prospective system is the constant temptation which arises thereunder to so resolve all questions involving personal judgment as to result in as favorable a rate as possible." In the first place the same argument in equal degree may be used with reference to the retrospective method. It should also be pointed out that the new Bureau plan involves but one method of procedure which is compulsory. We have in addition so interpreted the various questions which may possibly arise in its application that there are few, if any, which require the use of personal judgment.

In conclusion I should like to discuss a third point in Mr. Woodward's paper which has to do with the question of whether or not it is preferable to use actual experience instead of "average value" experience in the application of an experience rating plan. Assuming, if you please, that the prospective method of valuation is the one which will work out in practice and that experience rating should furnish the best available index of the capacity of a risk to produce accidents, I believe you will agree that the experience for the latest policy period should be used. The Bureau plan, for instance, provides for the determination of experience rates before the date of expiration of current policies upon the basis of past experience including the experience for nine months of the current policy year. In this way the plan keeps track of the latest developments in the experience of risks. Under these conditions the average value method of valuation is decidedly practicable and I should prefer it for this reason, if for no other. In fact, the use of average values is one of the safeguards which will in some measure

prevent the exercise of too much personal judgment. This is true even of the retrospective plan. Though it may be the case "that 90 days after the close of a policy period the number of open cases remaining are diminished to such an extent as to make their valuation on the basis of actuarial tables entirely feasible and satisfactory," it should be pointed out that while all accidents for the policy period may have been reported within such time, the ultimate nature of injury will certainly not be known in all cases. The fact is that any plan which requires the valuation of experience data at some certain date, carries with it the necessity for the exercise of judgment as to what the future developments in certain cases will be. The advantage of the average value method of valuation lies in the fact that once this judgment has been made, there is but one simple and direct method of treatment for each individual case which any one can understand and apply.

Does the use of average values tend to produce fictitious or hypothetical experience? Perhaps so, but what difference does it make if it does? There are but two instances in the average value tables of the Bureau plan where there can be a question of this character. These involve the valuation of the cost of death cases and temporary injury cases. However, I have heard of no one losing confidence in the plan for this reason. If question were raised, as to the method of valuing either of these two items, the explanation would be that the plan of experience rating measures the probable loss cost of the risk in the future with reference to the past capacity of the risk to produce accidents, and that upon such basis it is not important to view accidents from the standpoint of the financial loss in each individual case. It may be that a risk has produced ten fatal accidents in the past; its capacity to produce fatal accidents should be measured by this fact and it should be assumed that in accordance with the law of averages the occurrence of ten fatal accidents in the future will produce an average cost for accidents of this type. This assumption must be made in the prospective method because no one can foretell just what cost will result from the occurrence of similar accidents in the future. It does not follow, for example, that because a death in the past involved no dependency, every death in the future will involve no dependency. An assumption to this effeect would produce illogical results.

After all, even though experience rating is a method of individual rating, it is not a method which builds up a special rate for each risk. It is rather a method of measuring a variation from a carefully constructed average manual rate. If experience rating contemplated the promulgation of rates based entirely upon the individual experience of each risk, much that is said concerning the misuse of the law of averages and the impropriety of the use of certain methods of procedure would be amply justified. But the fact is that the experience rate, after all is said and done, is merely a modification of the manual rate in recognition of certain favor-

able or unfavorable tendencies in a risk, and that the method of computing this modification is strictly circumscribed. In the latest plans, for instance, the experience modification is restricted by a neutral zone and by definite maximum and minimum limits.

Mr. Woodward has fully recognized these principles, but in closing I should like to emphasize them, for I believe much of the criticism of experience rating as it is practiced would be eliminated if the object of experience rating were clearly appreciated and understood by all.

ORAL DISCUSSION.

MR. ALBERT H. MOWBRAY: According to his own remarks, Mr. Woodward has undertaken to present an impartial general survey of a very controversial subject. There are one or two things I would like to call attention to in connection, rather, with the general subject than Mr. Woodward's paper in particular.

The general schemes which have been presented so far, whether prospective or retrospective, all involve the possibility of a further charge upon the premium. I have been very much impressed with the remark of a friend of mine who is interested not so much from the actuarial side of the business as he is from the outside and dealing with the insured. He said to me that the intelligent employer would always strenuously object to paying any charges in his insurance premium which are expressed in what to him is an unknown language. If we could base our experience rating plans upon the actual experience of the insured, that would not be an unknown language to him. But there seem to be very good reasons advanced why we cannot do so.

Mr. Woodward speaks of the difference between expected and actual losses as a deviation of the experience, and points out what he terms the hazard deviation and the chance deviation, and it is the hazard deviation that we are trying to measure through experience rating.

If we look at his remarks on that subject at page 360 it seems pretty clear that the origin of the hazard deviation lies in the practical limitations of the classifications. If we could so arrange our classifications that they were accurately homogeneous there would be, it seems to me, no need for experience rating, because we would not have these so-called hazard deviations.

The possibility of doing so is further complicated by the limitation upon the amount of discretion we may allow to individuals, due to the competitive situation. Bearing that all in mind it still does seem to me that if instead of saying that we can't do certain things, we would take the attitude that we must do certain things, we might be able to find a reasonable, logical, practicable means of dividing risks into fairly homogeneous classifications as respects the morale or management hazards of the establishments. I have briefly referred to that in connection with the paper that I have presented at this meeting. While I don't mean at all that

I have solved the problem, it seems to me that ultimately, perhaps after a trial of our present methods of experience rating for a time, we will have to consider whether we can't do something along that line,—that is, along the line of further and more accurate classifications.

MR. RICHARD FONDILLER: It has occurred to me that it would be desirable to emphasize the distinction between open and closed cases of the temporary disability class, in the application of any experience rating plan. By an open case is meant one in which the injured employee has not recovered or returned to work at the date when the experience data is compiled. Under the plan in force in New York State, an average value of eight weeks compensation is assigned to all temporary total disability cases, irrespective of the fact of whether the case is closed or open. A practicable plan would be to prescribe a table by which the actuarial value of open cases could be ascertained by clerks without any special actuarial training. The valuation should be based upon the number of weeks that had elapsed between the date of the injury and the date of the valuation.

There is yet another class to which attention should be called, and those are the cases in which lump sum awards are being granted by the Commission. The official records rarely state whether the lump sum is to cover decreased earning power or whether it is a compromise settlement of a long-term temporary disability. The amounts of these settlements often run into considerable sums, and, from their very nature, it is difficult to assign these cases to any type of accident benefit. The rules prescribed for experience rating should make provision for cases of this character, by requiring the amount of the settlement to be reported.

The inclusion of the methods which I have outlined above, of handling the cases of temporary total disability and of lump sum settlements, would in all probability make a marked difference in the credit or debit to which employers would become entitled under a plan which does not differentiate these accidents from those classed as temporary total disability. In fact, a single case of either of these classes will often produce a debit, even where both the payroll and the premium are relatively large.

I am well aware of the fact that in any system of experience rating where average values are assigned to specific classes of accidents, it is inexpedient to introduce any refinements. However, in the light of considerable practical experience, I feel that the above suggestions are worthy of serious consideration in any plan of experience rating.

MR. WINFIELD W. GREENE:

(AUTHOR'S REVIEW OF DISCUSSIONS.)

In the second paragraph of Mr. Downey's discussion it is stated that "it has been argued with much cogency that the experience

rating of individual risks is *ipso tanto* contrary to the fundamental purpose of insurance."

It is true that I object to experience rating partly on the ground that it is contrary to the fundamental principles of insurance. It seems to me that there is no inconsistency in upholding schedule rating and opposing experience rating upon fundamental grounds, in view of the antipodal difference in the principles respectively involved in these systems.

In all forms of insurance the rating of a risk appears to involve three essential steps.

1. All prospective risks have to be classified.

2. A premium rate has to be computed for each classification. In theory this rate is based upon the loss experience of such classification.

3. The particular risk has to be assigned to the appropriate classification, whereupon the proper rate of premium becomes obvious.

The general practice in all forms of insurance (if we except the experience rating of compensation risks) has been to confine the rating of the individual risk to the third of the processes noted above. It has not been found advisable to rate the individual risk by a combination of the second and third processes.

Schedule rating means merely a refinement, or, if you will, a complication of our system of classification. In applying the schedule to the individual risk, we merely determine by a more complicated process to what classification it belongs. Schedule rating is therefore not inconsistent with the practice generally obtaining in other lines of insurance. The schedule rating of fire risks and the rating of substandard risks in life insurance are examples of this consistency.

There is, I believe, no well-founded justification in insurance experience for the belief that in the long run it will be desirable or even practicable to rate the individual risk wholly or in part upon the basis of its own experience. Premium rates and schedules should be general in their nature and should be the result of a dispassionate scientific analysis of experience. Experience rating means a computation of a separate rate for each risk affected, an expensive procedure and one which it will be most difficult to conduct in an unprejudiced manner. Moreover, when under experience rating the individual rate has been computed, the result is ninety-nine times out of a hundred absolutely without significance, since in a majority of instances the risk will not be so large as to develop any consistent relation between actual experience and true hazard. Mr. Downey himself points out that it appears very doubtful whether any form of experience rating will make insurance attractive to an employer whose payroll is so great as to yield a dependable pure premium.

Mr. Downey further states that in his opinion schedule rating is

inadequate because of its failure to grade "(*b*) difference in processes and produce and (*c*) difference in morale, under which term are comprised shop organization and discipline, methods of work, safety instruction, and the permanence, intelligence and industrial training of the working force." I submit that already schedule rating deals with many of these things in part at least, and that there is reason to believe that schedule rating can be so improved as to cover this ground pretty well. Moreover, schedule rating looks to the tangible things in organization and equipment, and where the schedule is rigidly and impartially interpreted, the employer is made to feel that his premium rate depends upon what he *does* in the way of accident prevention. Experience rating on the other hand looks to the accident record in which the element of chance must necessarily play an important part.

I am yet to be convinced that any system of experience rating, however restricted and graduated according to the size of the risk, will prove popular among employers. The popularity of the mutual principle in compensation insurance does not weaken my conviction in this regard. It is significant that the popularity of the mutual principle rests upon the *consistent* realization of dividends, and not upon the realization of dividends and the payment of assessments in rapid alternation. Perhaps I emphasized unduly the possibility that experience rating would give the employer an incentive to discourage claims for compensation, although I note that Mr. Fellows thinks otherwise. There is, however, a very real problem arising from the adoption of the workmen's compensation system, which I believe would be aggravated by a general adoption of experience rating. I refer to the tendency upon the part of employers to discriminate when selecting employees, against persons advanced in years or possessing some slight physical defect. There can be no doubt that in some states and in some industries, the adoption of a compensation act has made it well nigh impossible for a workman handicapped by even comparatively slight physical defects to secure employment.

The field of schedule rating is constantly broadening and its basis is being steadily improved. We can hardly hope for an absolutely equitable system of rating in any form of insurance. Even in life insurance, where practice has attained stability and a reasonable scientific plan, it is obvious that no two risks rated alike present in fact the same life expectancy.

If, however, the demand for experience rating cannot at this time be waved aside, I would commend the method outlined by Mr. D. S. Beyer in the *Economic World* of April 15, 1916. Under his plan a certain proportion of the premium charged is made proportional to the frequency of compensated accidents. The advantage of this method lies in the superiority of accident frequency, especially the frequency of compensated accidents, over monetary loss as a criterion of true hazard, in the case of the great majority of

insured risks. The simplicity of Mr. Beyer's plan is also important in reducing clerical labor and expense to a minimum.

MR. JOSEPH H. WOODWARD:

(AUTHOR'S REVIEW OF DISCUSSIONS.)

It is most gratifying to observe the considerable number of full and careful discussions of this subject which have been presented.

As to the main points involved, it is satisfactory to note that there is on the whole remarkably little divergence of opinion on the part of those who have given attention to this question. In any matter where the basic theory is so intricate and where the practical application involves so many conflicting considerations there is bound to be considerable difference of view.

Mr. Downey, for example, while he does not go so far as to favor the use of a uniform value for every compensatable accident, does believe that death losses should be, in effect, eliminated from the experience. I am inclined, however, to believe that the results sought by Mr. Downey are better obtained in another way.

Mr. Michelbacher has written in favor of the prospective as distinguished from the retrospective method of rating. His main arguments are arguments of practical expediency. As such, they are not, of course, to be disregarded, but where they come into conflict with theoretical considerations I think it will be agreed that they should be minimized as much as possible.

Mr. Senior has supplied a very valuable analysis of the experience rating plan adopted in New York State subsequent to the time at which my paper was written. Among other matters he presents an ingenious defense of the use of a combination of the payroll and the premium for measuring the size of a risk for experience rating purposes. I believe, however, that such a system is theoretically incorrect and that the size of the risk for experience rating purposes is a function of the premium alone. Mr. Senior says:

"The use of the premium test . . . is open to the objection that in the high-rated classifications certain risks will become eligible for experience rating on account of the high premium, although showing a low exposure measured by the number of lives at risk."

As a matter of fact, the higher the premium rate the smaller the total premium which is required to secure average results, for the reason that the number of death and other serious losses expected is high in proportion to the total number of accidents expected. Mr. Senior also presents a defense of the use of an average basis of valuation of accidents, without regard to the actual cost of the accidents. I fully recognize the popularity of this view among compensation underwriters, and it undoubtedly serves to avoid a good many troublesome questions of valuation. However, after

having observed the practical operation of such a system in a good many concrete cases, I feel inclined to adhere to the view that the nearer we can attain to the true incurred loss under the risk the more satisfactory will the system work. Under the average value system, a risk with a very unfavorable experience may possibly, under the rules, obtain a credit for good experience, whereas some risks are charged a debit for bad experience where, as a matter of fact, they have cost the carrying company very little. All this is apt to come to the attention of the employer and to upset his confidence in the equity of the rating system.

In closing this discussion, I wish to take the opportunity to express my appreciation of the valuable paper contributed by Mr. Greene on this subject. While not agreeing with Mr. Greene in all of his premises or conclusions, I think that he has done great service in presenting for our consideration so sound and conservative (perhaps I might say ultra-conservative) a view of this question. The points of difference between Mr. Greene and myself are obvious from a comparative reading of the two papers; nevertheless, I personally should prefer to see a general adoption of the views of Mr. Greene if the alternative were the adoption of views going to the opposite extreme.

VALUATION OF PENSION FUNDS, WITH SPECIAL REFERENCE TO THE WORK OF THE NEW YORK CITY PENSION COMMISSION.—GEORGE B. BUCK.

VOL. II, PAGE 370.

WRITTEN DISCUSSION.

MR. JAMES D. CRAIG:

Mr. Buck's paper is a short synopsis of his work in connection with the reorganization of the pension funds for the City of New York. As stated by him:

"With the exception of certain tables for school teachers and for police, the former prepared by Messrs. Hutcheson and Thompson and the latter by the author, there were no basic tables on which calculations, prospective costs or pension liabilities could be made."

The paper here presented gives a general discussion of the construction of the basic tables prepared and discusses particularly two features of the actuarial calculations which are of interest to the members of this Society.

It therefore follows that the paper presented should be read in connection with the published "Report on Pension Funds of the City of New York," Part 2. Considered together, they form a monument to Mr. Buck which must necessarily appear larger and more imposing as years pass on. To quote from his paper:

"The fact that New York City is a pioneer in this field gives peculiar value to the results of its experience."

While the volume of data investigated adds greatly to its value, a careful study of Part 2 is necessary to appreciate the difficulties under which Mr. Buck labored. Nine separate funds were valued, the data of which were combined where necessary, as in the study of conjugal relations or family history, while the necessary tables were prepared for the great variety of benefits promised. As the different funds covered nearly every form of benefit peculiar to pension funds, the tables and formulæ were necessarily complicated.

The family history data furnishes a long-felt want, as, with the exception of a few scattered experiences of small magnitude, the only experience of this description up to the present time was that developed in New Zealand.

In presenting a discussion of his paper, where completeness is at once recognized, all we can hope to do is to clarify some thoughts which may not be perfectly evident to those who have not had the privilege of giving careful study to the report, and we might first observe that it would have been slightly easier to compare the two

publications, had Mr. Buck inserted the symbols with the same completeness in his paper as in the report. The report gives the exponential a in parenthesis over the respective q's, whereas these do not appear on page 375 of the paper, which employs symbols that are more general than specific. Also, the equation on page 376 might be modified somewhat. The expression $l_{[x-2]+1}$ is rather an unusual one. From the general understanding of select notation, the implication is that only one year of service has been experienced on a life insured at age $(x-2)$, while as used by Mr. Buck, it represents the number who have experienced two years of service and are entering upon their third year. It would seem as though this equation might be written:

$$l_{[x-2]+2} = \frac{l_{x+1} + (d + {}^{i}r + {}^{o}r)_x}{1 - ({}^{rw}q + {}^{dw}q)_{[x-2]+2}}.$$

The paper emphasizes two special methods used in constructing various tables in the report. The first, showing the construction of an active service table, taking into account the question of selection, is a subject over which there has been and probably will continue to be a great deal of discussion. As much care as possible should be exercised in the construction of valuation factors and the experience of each fund should be carefully studied before making a valuation, but it must be remembered that after the valuation factors are prepared and a reorganization scheme proposed, the functions used in the valuation are very often discarded and new assumptions made for the future. The method proposed for the construction of active service tables to be used in valuation on the theory that some of the factors must be in select form is very ingenious. It combines practicability with a high degree of theoretical accuracy. The rates of dismissal and resignation have been put on a strictly select basis, but, as pointed out, no benefits are payable upon resignation or dismissal and select commutation columns for these contingencies are therefore eliminated.

Perhaps no harm would be done in bringing out clearly why resignations and dismissals should be treated on a select basis when no benefits are predicated thereon. Obviously, all contracts consist of a payment, as well as a benefit side, and while no benefits are allowed for resignations and dismissals, they nevertheless form an important function in determining the membership still active and consequently must be given careful consideration in making the valuation of payments.

Although this method of constructing the service table reduces to a minimum the number of commutation columns required, it should nevertheless be noticed that it does not eliminate the necessity of classifying the experience into length of service. If the valuation has to be made with regard both to the number of years in service and the number of years of future service before a man becomes

entitled to a pension, the work will not be materially reduced, except as Mr. Buck says, on page 307:

"We resort to some arbitrary grouping for the sake of reducing the amount of labor required in the valuation work."

If the value of the benefits depends upon the length of service, the detail involved in the groupings can be materially reduced.

While only the resignations and dismissals are treated on the basis of select tables, nevertheless the effect is to make some selection apply on deaths and disability. Mr. Buck recognizes this where he says:

"That this method automatically causes a reduction in death and disability rates in the select years of experience is apparent."

This would seem an advantage, rather than a disadvantage, as it is reasonable to suppose that in the first few years after entrance these rates will be somewhat lower than the ultimate rate, due to medical fitness at the time of appointment becoming more or less universal.

The second special method is for the valuation of service pensions, depending upon the length of service of the employee. Mr. Buck gives three different subdivisions for this valuation, depending upon the purpose of the valuation, the peculiarities of the fund and the magnitude of the data.

The first subdivision recognizes that the service tables provide for retirements before employees entering at more advanced ages would be eligible for retirement and consequently excludes these retirements in determining the values for the later years of entrance. The principle here is that those retiring before the necessary period expires are considered to remain on the active list and then retire in a body. The effect is practically to add a pure endowment element and, as pointed out, can only be used if the new entries from year to year fall within relatively close limits as to age distribution. With most municipal pension funds, this condition is apt to exist and, apparently, the method was generally used in New York. This method produces the lowest value, which might have influenced the Pension Commission, as is stated:

"The Pension Commission insuring the liability of the City as regards pensions preferred rather to under-state than over-state liability."

It may be that after the funds are re-established, sufficient funds will be available to warrant a more stringent valuation. The formula given by Mr. Buck, on page 380, for the supplementary l column is:

$$^{or}l_x = \left({}^{or}l_{x-1} + \frac{{}^{o}r_{x-1}}{2} \right) p_{x-1} + \frac{{}^{o}r_{x-1}}{2}$$

and may take the form:

$$^{or}l_x = {}^{or}l_{x-1} \cdot p_{x-1} + \frac{{}^{o}r_{x-1}}{2}(1 + p_{x-1}).$$

By putting in this form, it is evident that the retirements are considered as being at risk of death for half a year and this would be correct where the service tables are predicated upon this basis. If the deaths and retirements are assumed to occur at the end of the year, the formula would reduce to:

$$^{or}l_x = {}^{or}l_{x-1}d_{\cdot x-1} + {}^{o}r_{x-1},$$

which is a somewhat simpler form.

The second subdivision divides the experience according to service *prior to the period of eligibility and service thereafter.* This method is, as Mr. Buck says, about the most satisfactory way of valuing service pensions, its practical objection being that when combined with the valuation factor for other benefits it greatly increases and complicates the work. Primarily, it is not adapted for use in small or new funds, as extensive data is necessary for the construction of factors. If Mr. Buck could, at his convenience, give us some of these tables based on the New York experience, he would still further increase the indebtedness of the Society to him.

The third subdivision, which Mr. Buck really discusses as the first, is the valuation of the benefits as regular deferred annuities. This undoubtedly is the simplest method, but produces too high values under practical conditions, as a large number of employees do not retire as soon as they are eligible on account of the reduction in their income. The uncertainty as to the retirement of an employee after eligibility exists with its consequent uncertainty as to the resulting valuation factor probably influences the actuary and causes him to agree with the social economist and general student of pensions in the contention that service pensions should not be payable until, say, age 65 and that compulsory retirement should occur within a very few years thereafter.

As previously stated, Mr. Buck has presented a valuable work in the study of these funds and has greatly added to our information by the description of his formulæ, but this is only preliminary work and the real constructive work is only commencing. New tables must be prepared, based on the history of the past which will allow for the expectancies of the future. The public at large must be impressed with the real cost of these benefits and legislatures must be taught that when benefits for any class of employees are written into the statutes, provision should be made to secure them fully. The disappointment now being experienced by the school teachers and other beneficiaries of the pension funds of New York City is not in being deprived of any of the benefits for which they have paid, but simply in having been caused to expect more than it was possible to grant, while the disappointment of the citizens of the city is due to the same failure of results as compared with early expectations.

When pensions are promised under legislative action or other-

wise, provision should be made therefor. Mr. Pritchett, President of the Carnegie Foundation, in his recent paper entitled "A Comprehensive Plan of Insurance and Annuities for College Teachers" states:

"The employee entering his vocation and looking over a span of thirty or forty years to the protection of his pension is most of all concerned in its security. If he is to plan his life upon the use of a pension at an agreed age, he desires above all absolute certainty that the pension will be ready at the date named."

In order to make such a situation in regard to municipal pensions, Mr. Buck states:

"The fund should have as strict supervision as the law places over our life insurance companies, in order that the rights of employees who are the beneficiaries may be protected just as strongly as the rights of policyholders are protected and in order that the city may not contribute to an improperly constituted fund."

There has probably been no one thing in this country which has gone as far toward accomplishing these purposes as the results published by Mr. Buck and this Society may feel honored that he has taken us into his confidence and explained to us his methods.

MR. HENRY MOIR:

I am glad to be present for the first time at one of your meetings and to take part in the discussion of this subject. Your Society has already done much good work and although when you discuss pension problems you are coming very close to, if not indeed jumping right into, work which is clearly within the scope of the Actuarial Society of America, nevertheless it is to be expected that the two societies must have some borderline work where they meet and dovetail into one another. Pension funds constitute one of the subjects which may in this way bring us closer to one another, and I am glad to see such a good paper on this subject presented to your Society by Mr. Buck.

The question of pension funds is a continually growing one; the subject has only been touched upon yet although much seems to have been written. The development of pensions has scarcely begun and but little prophetic vision is needed to foretell that in the course of fifty years there will be an immense number of pensioners. There will then be larger industrial organizations than exist to-day and most of them will have in full operation a pension plan for their aged and infirm employees. Not only so, but in all probability there will also be a national system of old age pensions to take care of those who are *not* protected through their industrial work. I anticipate therefore an expansion of the pension system similar to the expansion which has taken place in life insurance in this country since the Civil War.

Mr. Buck has touched upon some of the difficulties met by the actuary in handling pension problems. He has dealt more with

the question of retirement than with any other of the difficult questions, and his paper will enable students to get some conception of the methods of approximation which must be used in handling pension problems. The rate of retirement is a fluctuating quantity. It varies with the rise and fall of industrial activity which may be nation-wide; but it also varies through the transference of labor from one industry to another. Sometimes one particular industry may be relatively dull at the time when others are unusually busy. We have seen this in the recent past when all metal trades became suddenly active after the war broke out, without corresponding activity in other directions. But the activity in the metal trades gradually spread itself to nearly all industries and now after nearly two years of boom conditions in the metal industries, we find that practically all other lines of endeavor in the United States have reached a similar condition of activity. If the war were now to cease, the retirement rate amongst workers in the metal trades would be rapid and immediate, but in my judgment a fair measure of prosperity would continue in the general industries of the country. I mention these points in order to show how the rate of retirement is affected in various industries—how it may fluctuate, and how cautious actuaries must be in making assumptions or in using rates of retirement derived from past experience. I am led also to refer to the employment rate which Mr. Buck has scarcely touched upon, but which is an equally important problem in many of the pension plans coming before actuaries. A business with two or three hundred employees may suddenly expand until they employ five or six hundred, and under some pension systems, as for example the New York City Teachers, each new employee adds to the liabilities of the fund without an offsetting asset. This is a disturbing element which is of great importance unless each new employee contributes in direct relationship to his age, condition, and the benefit he is likely to obtain.

In a discussion of this kind I think that speakers should be critical as well as complimentary. Accordingly I would direct attention to the use of the symbol q by Mr. Buck as meaning something entirely different from the probability of dying. Indeed it is used simply as a decrement symbol, which I think somewhat unfortunate. Moreover one is apt to confuse a little the "rate" of dismissal with the "probability" of dismissal within a year—two different functions.

Then again Mr. Buck makes two statements, both of which are in my judgment a little too sweeping. On page 381 he says:

"It is now generally recognized that every pension fund is a law unto itself and that no general active service or valuation tables or rules of procedure can be formulated, which are applicable to all funds."

The differences in treatment are necessarily great, as already indicated, yet the main principles are fixed, mathematical, and scien-

tific, so that students should avoid hasty conclusions which they might draw from the remark that "every pension fund is a law unto itself."

Then again, Mr. Buck goes to what I consider the other extreme on page 384 where he indicates that eventually pension fund "methods will be as clean cut and as general in their application as ordinary life insurance formulæ." It seems to me that we can never quite get away from the intricacies of such calculations, and students must expect these intricacies as part of the burdens which fall upon their shoulders in studying pension problems.

MR. GEORGE B. BUCK:

(AUTHOR'S REVIEW OF DISCUSSIONS.)

To review the very courteous discussion of the paper on pension fund methods was a pleasure to the author, especially in view of the rather complimentary statements of the critics.

I am grateful to Mr. Craig for calling attention to the expression which he terms "rather an unusual one." The equation is probably in better form when written as he has expressed it, or as it appears in somewhat more general form in the report on the pension funds of New York City, to which he refers. There the equation appears on page 30, as follows:

$$l_{[x]+t} = \frac{l_{[x]+t+1} + (d + {}^{i}r + {}^{o}r)_{x+t}}{1 - ({}^{r}w q + {}^{d}w q)_{[x]+t}}.$$

To the objection of Mr. Moir, that the symbol "q" should not be used in connection with the probability of dismissal or any decrement other than death, I would hesitate to agree at this time. Mr. Henry Manly, in his paper on the valuation of staff pension funds (*J. I. A.*, Vol. XLII, pp. 4 and 5), read before the Institute of Actuaries, speaks of the rate of withdrawal, in regard to the probability of members leaving the service within one year by causes other than death, and employs the symbol ${}^{w}q_x$, which is the same as I have used. Mr. George King, in his paper on staff pension funds (*J. I. A.*, Vol. XXXIX, p. 134), uses practically the same words and almost the same symbols in saying "We have . . .

The rate of withdrawal, $q_x^w = \frac{w_x}{E_x}$.

The rate of mortality, $q_x^d = \frac{d_x}{E_x}$."

Mr. Dwight A. Walker, in his paper entitled "A Staff Pension Fund" (*T. A. S. A.*, Vol. XVI, p. 112), read before the Actuarial Society of America, speaks of the rate of withdrawal from the service, in connection with the probability of leaving the service by

resignation or dismissal, and employs the symbol q_x^{aw} in this regard. These citations cover the majority, if not all, of the cases where the probability of withdrawal from service within one year has been employed in papers read before either the Institute of Actuaries of Great Britain or the Actuarial Society of America. The use of the symbol as given in the paper is therefore not without precedent in the two societies, which would have been the case had a new symbol been invented for use in the paper. I am in agreement with Mr. Moir on the general principle that a single symbol should not be put to too many uses, but I would nevertheless regret to see destroyed a practice which has become more or less universally established unless some better practice were generally substituted in its place.

Perhaps the statement on page 381, "It is now generally recognized, etc.," to which Mr. Moir refers, does not convey the meaning which was intended. I was seeking to bring out the fact, that the possibility of obtaining sufficient data from any one fund upon which to predicate so many different tables as were referred to in the preceding sentence, was remote. This statement seems to suggest the combination of the experience of several funds as a basis for such tables. Mr. Manly, in one of his papers (*J. I. A.*, Vol. XLV, p. 182), stated that at first he believed that general tables might be developed which would be applicable to many funds, but that later he came to the conclusion that this was not practicable. By my statement that "each fund is a law unto itself" I meant that each fund should be valued, so far as is practicable, on its own experience, and that the active service tables of one fund are not generally applicable to other funds. This sentence was intended to answer the suggestion that the statistics for several funds should be combined. On account of this difference in the experience of various funds it is difficult to state whether it is advisable to work all funds on a select basis, on an aggregate basis, or on some combination of the two, because the experience of some funds would give practically the same results regardless of the methods employed, while in others the results would be quite different. It would, therefore, seem difficult to prescribe any definite rules of procedure to be followed in handling the data collected in regard to a pension fund.

On the other hand, by my statement that "methods will be as clean cut and as general in their application as ordinary life insurance formulæ," I meant to convey the opinion that, despite the intricacies of such calculations and the difficulty in determining the general rules of procedure to be followed in valuing a fund, nevertheless the mathematical work and the main principles to be followed would become general, so that, after the method of procedure was decided upon, the principles and methods of making the mathematical calculations would be about the same for all funds.

A PRELIMINARY TEST OF THE COAL MINE RATING SCHEDULE OF THE ASSOCIATED COMPANIES—E. H. DOWNEY.

VOL. II, PAGE 387.

WRITTEN DISCUSSION.

MR. G. F. MICHELBACHER:

Mr. Downey's clear statement of the results of the application of the Coal Mine Rating Schedule of the Associated Companies to Pennsylvania coal mining risks indicates that the theory upon which this schedule is constructed is well worth the careful consideration of all students of the schedule rating problem. It may be that the solution of a great many of our schedule rating difficulties can be found in a thoroughgoing analysis of the underlying principles upon which the Schedule of the Associated Companies is constructed. Without attempting to point out the practical application of the theory to the problem of rating manufacturing risks I should like to go a little deeper than Mr. Downey and Mr. Wilson have gone into the mathematics of the schedule and explain the development of its general formulæ.

The fact that the Schedule of the Associated Companies is most simple in its fundamental principles is fully demonstrated by the ease with which it can be reduced to a formula. Papers analyzing our present manufacturing schedules have been presented before this Society on various occasions. The discussion in each case has been considerably involved and the results, though in general somewhat similar, have been at variance in respect to many details. The fact is that our manufacturing schedules have not been constructed to formula in more than a haphazard way. If one can be reduced to a formula, it is often a more or less happy coincidence. The Schedule of the Associated Companies, on the other hand, is entirely constructed to formula; that is to say, instead of constructing a schedule and then puzzling out a formula to fit it, Mr. Wilson, author of this schedule, first constructed a formula and then built a schedule upon it.

Before attempting to develop the formulæ which underlie the Schedule of the Associated Companies, it may be well to recall some of the more important facts in connection with the schedule. This I may do briefly as follows:

1. The schedule contains nothing but charge items. Credit can be given only in a negative manner, that is to say, by not assessing a charge against the risk.

2. The schedule is divided into 12 general groups upon the basis

of accident causes. For example, Group 3 contains all items bearing on "Surface Hazards"; Group 4 all items which have to do with "Shaft Hazards," etc.

In recognition of the fact that the frequency and cost of accidents vary for these general causes, the groups have been assigned weights which measure the relative importance of each class of hazards. The total hazard produced by all causes is measured by the value 100; the weight for each group is therefore a fractional part of 100 and the sum of all such weights is 100. These weights do not vary from mine to mine within a given state. They do vary from state to state, however, and in this way they reflect certain local physical conditions which affect all mines within the state boundaries, such as the presence or absence of coal gas in explosive quantities, the general character of the mine roof, etc.

The schedule in general therefore resolves itself into the following chart:

Group Number.	Weights for Groups.	Weights for Hazard Items Within Groups.	Actual Sum of Weights for Hazard Items Determined upon Inspection.
I.....	W_1	a_1 a_2 a_3 . . . Total 100	p_1
II.....	W_2	b_1 b_2 b_3 . . . Total 100	p_2
.	.	.	.
.	.	.	.
.	.	.	.
XII.....	W_{12}	m_1 m_2 m_3 . . . Total 100	p_{12}
	Total 100		

3. Each group is then divided into a number of items. Each item represents a factor which contributes to the particular hazard of the group. These items likewise have been assigned weights in recognition of their relative importance. The sum of these weights

is 100, consequently the weight for each item is a fractional part of 100. The weights of these hazard items are constant for mines everywhere. The sum of the weights for the items within each group varies from mine to mine, however, in accordance with the condition of the individual mine found upon inspection. If an inspector should find it necessary to assess all the charges in any group against a certain mine, the sum of weights for that group for such mine would be 100. If, on the other hand, no charges were assessed, the sum would be 0. Generally, one or more charges are assessed so that the usual condition is a sum between 0 and 100.

Assuming conditions as outlined in the above chart, the following equations are true:

The charges for the worst possible mine will be

$$W_1(a_1 + a_2 + \cdots) + W_2(b_1 + b_2 + \cdots) + \cdots W_{12}(m_1 + m_2 + \cdots),$$

where

$$W_1 + W_2 + \cdots W_{12} = 100$$

and

$$\begin{aligned} a_1 + a_2 + \cdots &= 100 \\ b_1 + b_2 + \cdots &= 100 \\ \cdot \quad \cdot &\quad \cdot \\ \cdot \quad \cdot &\quad \cdot \\ \cdot \quad \cdot &\quad \cdot \\ m_1 + m_2 + \cdots &= 100 \end{aligned}$$

That is to say, where every available charge is applied, the sum of the charges for this mine, which is theoretically the worst possible mine, total 10,000. To reduce the total charges to small numbers, the rule has been established that the result shall be divided by 10,000 to determine the so-called Coefficient of Hazard.

Now, let X represent the Coefficient of Hazard.

Then $X = 1$ for the worst possible risk.

Similarly $X = 0$ for the perfect risk where no charges are applied and where consequently,

$$W_1 + W_2 + \cdots W_{12} = 0$$

and

$$\begin{aligned} a_1 + a_2 + \cdots &= 0 \\ b_1 + b_2 + \cdots &= 0 \\ \cdot \quad \cdot &\quad \cdot \\ \cdot \quad \cdot &\quad \cdot \\ \cdot \quad \cdot &\quad \cdot \\ m_1 + m_2 + \cdots &= 0 \end{aligned}$$

For the usual mine, some of the weights of the individual items will be lacking for the reason that the inspector will list only such items as the physical conditions of the risk cause him to list.

Using $p_1, p_2, \cdots p_{12}$ to represent the sum of the weights of the items in each group which are actually listed by the inspector in his report, the Coefficient of Hazard for the usual mine becomes:

$$X = \frac{W_1 p_1 + W_2 p_2 \cdots W_{12} p_{12}}{10{,}000}.$$

This is of course the general formula, for either the perfect or the worst mine can be represented by it. For the perfect mine the functions $p_1, p_2, \cdots p_{12}$ have individual values equal to 0; for the worst possible mine, they have individual values equal to 100.

Thus the value of X may vary from 0 to 1 and it is fractional for the ordinary mine.

Having determined the mathematical form of the coefficient of hazard, let us now consider the problem of the determination of the adjusted rate. Naturally, the exact relationship between the coefficient of hazard and the adjusted rate must be assumed. Let us therefore assume this relationship to be linear. It will then be represented by the usual linear equation:

$$Y = aX + b,$$

where

$Y =$ final adjusted rate

and

$X =$ coefficient of hazard.

The problem is to determine the parameters a and b and thus to establish a general relationship between the coefficient of hazard and the adjusted rate.

It is obvious

1. That the coefficient of hazard for the average mine should correspond to the base rate; in other words, that if an average mine is found upon inspection, the average or base rate should be assigned to such mine.

2. That when the coefficient of hazard is 0, the adjusted rate should be the minimum rate, that is the lowest rate at which business of this character can be underwritten.

Let us assume that

$B =$ base rate (average or manual rate),
$L =$ value of the coefficient of hazard for the average mine,
$U =$ greatest percentage reduction in the base rate for the best risk—in other words, that the lowest possible rate is $(1 - U)B$.

Then, in accordance with the two propositions advanced above,

(1) $$B = aL + b,$$

(2) $$(1 - U)B = a(0) + b.$$

From these two equations

$$b = (1 - U)B,$$

$$a = \frac{UB}{L},$$

and

$$Y = \frac{UB}{L}X + (1 - U)B$$

or

$$Y = \frac{B}{L}[U(X - L) + L].$$

This is the final form of the general formula by which adjusted rates are produced from the coefficient of hazard. It will be noted that the value Y can absolutely be controlled by the values U and L. The determination of the value of U is an underwriting problem, as the value of this factor establishes a minimum rate and consequently involves a discussion of the lowest cost at which business of this character can be underwritten. The determination of the value of L, on the other hand, is an actuarial and an engineering problem. It is an actuarial problem, inasmuch as it depends in some measure on a careful analysis of statistical data. It is primarily an engineering problem, however, because it involves scientific knowledge of coal mining conditions generally, and the use of considerable technical information as the basis for judgment as to the effect of safety measures in the prevention of coal mining accidents.

It has been possible to determine the values of U and L with considerable accuracy, as Mr. Downey's tabulations indicate. It will be possible by keeping in touch with conditions in the coal mining industry and in underwriting procedure absolutely to control the application of the schedule in the future and this, I take it, is the one feature which causes the Coal Mine Schedule of the Associated Companies to stand out as one of the most satisfactory and workable schedules yet developed.

MR. WILLIAM NEWELL:

In view of the fact that it is desirable to have fresh in mind the salient features of the coal-mine rating schedule described by Mr. Herbert M. Wilson in his paper entitled "Inspection and Schedule Rating for Coal Mine Insurance" (*Proceedings*, Vol. II, p. 39), when discussing Mr. Downey's paper, I trust that I may be pardoned for restating briefly the method employed in devising the Coal Mine Rating Schedule.

The Schedule assumes the theoretically perfect mine and establishes standards for each item of hazard in that mine with relative

charge values for failure of any item to comply with the standard adopted. It then establishes as the basis rate for each state or coal-mining district that rate which would apply to the average mine. It is only necessary then to take the total number of charges or deviations for the particular mine from the standard mine for that district, compare this with the number of charges which correspond with the average mine for the state or district, and the difference is the deviation from the average mine, or the number of credits or charges against the particular mine. These applied to the base rate for the state or district give the adjusted schedule rate sought.

The base rate adopted for each state or district was computed from the experience or statistical data tabulated by the Bureau of Mines from a study made of the causes of 49,733 fatalities recorded by state mining departments. These records extend over periods ranging from five to forty years, according to the state. Only the more recent data acquired since the formation of the Bureau of Mines in 1910, however, has been used in developing the experience multiples or weights used in each of the twelve classes of accident prevention measures adopted as a basis of the rating scheme. This was done because the statistics of fatalities for the earlier years were not so reliable. The Associated Companies has tested this data by the records of serious injuries which, though probably not accurate in any state, are doubtless reasonably consistent as to ratio of causes.

I assume, from reading Mr. Wilson's paper, that the standard mine is a mine in which all accidents would be classed as unpreventable by any practical means and, therefore, due to the inherent trade risk. I further assume that 40 per cent. of the accidents, or rather 40 per cent. of the accident cost or pure premium loss, is classed as preventable and 60 per cent. as unpreventable, inasmuch as the maximum reduction allowed from the base rate is 40 per cent., which presumably is the reduction for a mine which complies with the standards in all respects. It will be noted from Tables II and III of Mr. Downey's paper that only one anthracite mine out of 75 and 7 bituminous mines out of 845, or a total average of less than one mine in a hundred was entitled to a reduction in base rate of over 30 per cent. Neither are the charges on the poorer risks excessive, as is shown by the fact that no anthracite mines, and only 16 bituminous mines, showed an increase in rate of over 20 per cent. This certainly speaks very well for the excellent judgment used in assigning the charges and their relative weights in the schedule.

It is of interest to ascertain the relation between the size of the risks and the rate groups or merit-rates. With this end in view, I have calculated from Tables II and III the average payroll per risk for each rate group and give same below:

TABLE II.

RATE DISTRIBUTION OF ANTHRACITE MINES.

Rate Group.	No. of Risks.	Payroll.	Average Payroll per Risk.
Total.....	75	$11,393,900	$151,918
60- 70%	1	$ 30,000	$ 30,000
71- 80%	10	320,900	32,090
81- 90%	25	3,391,900	135,676
91-100%	30	6,585,600	219,520
101-110%	7	805,500	115,071
111-120%	2	260,000	130,000

TABLE III.

RATE DISTRIBUTION OF BITUMINOUS MINES.

Rate Group.	No. of Risks.	Payroll.	Average Payroll per Risk.
Total.....	845	$41,158,200	$ 48,708
60- 70%	7	$ 39,300	$ 5,614
71- 80%	59	1,447,400	24,532
81- 90%	202	9,339,200	46,233
91-100%	316	12,774,800	40,426
101-110%	201	12,738,400	63,375
111-120%	44	3,298,300	74,961
121-130%	9	662,300	73,589
Over 130%	7	858,500	122,643

We see from the above tables that with the exception of the two higher rate groups of the anthracite risks, and one or two slight variations in the bituminous risks, the charges, and consequently the rates, increase with the size of the risk. This is just the opposite of what happens in the application of the Universal Analytic Schedule, or as it is now known in its revised form, the Industrial Compensation Rating Schedule, to manufacturing plants. In the latter case it is the larger plants which receive the larger rate reductions, and the smaller plants which receive the larger rate increases. (This is due largely to the fact that, in general, the larger plants are in better condition from the standpoint of both physical and moral hazard.) In the case of coal mines, the reverse is apparently true, and as Mr. Downey is in a much better position than I am to get at all the statistics or facts bearing on this point, I think it advisable to leave the explanation thereof for him to take up in his review of the discussions.

Referring to Tables IV and V, Mr. Downey calls attention to the fact that the closest correlation between the per cent. of total charges actually developed and the state weights is found in the group of charges for conditions affecting falls of roof and coal. It seems to me that a logical explanation for this may be found in

the fact that accidents due to this cause are usually fatal or serious, and, therefore, the statistics of same are more complete than in the case of some of the other groups. Furthermore, there is apt to be a much smaller percentage of error in reporting the cause of accidents in this group than in some of the other groups where the exact cause of the accident, and consequently the proper group to which to assign it, might not be as clearly defined.

Mr. Downey further calls attention to the fact that there is a rather consistent deficit in the minor items of the realized, as compared with the expected, charges. May this not be due to the fact that the groups in question primarily comprise charges for physical hazards which it is possible to overcome in a large degree by mechanical safeguards, and that the conditions covered by such groups have improved even since the statistics on which the state weights are based were collated.

In closing, I merely desire to reiterate Mr. Downey's advocation of a schedule rating system which is subject to statistical control, and for this reason, as well as others which he has mentioned, the coal mine rating schedule cannot fail to make a strong appeal.

OUTLINE OF A METHOD FOR DETERMINING BASIC PURE PREMIUMS—ARNE FISHER.

VOL. II, PAGE 394.

WRITTEN DISCUSSION.

MR. ALBERT H. MOWBRAY:

The keynote of Mr. Fisher's paper is found in the second paragraph of his "Introductory Remarks":

"In view of the complexity of the problems of social insurance it will, I think, generally be allowed that the statistical methods hitherto employed are frequently inadequate. For this reason, I deem no apology necessary in presenting a method that, as far as uniformity and general systematic procedure is concerned, exceeds any other covering the same ground.

"It is my opinion that in the solution of the problems of social insurance we ought to follow the modern statistical methods of the English biometricians and continental statisticians, especially the Scandinavians, rather than the old methods put forward by life insurance actuaries."

We are in the unfortunate position of all pioneers and beginners who are urged with equal emphasis to follow diametrically opposed courses. Most of us will recall that at our first dinner Mr. Hoffman strongly advised us to shun the pitfalls of the mathematical school, of which Pearson and the English biometricians are the principal exponents. Now Mr. Fisher sees in their method the greatest boon for our work.

Mr. Fisher, himself, says the great work in this field has only been done within the last ten or fifteen years, and unfortunately it is little known in America even to our university men. He must then expect us to have much difficulty (assuming we were to accept his views) in persuading practical men of affairs like our executive officers that there is enough to be gained by such methods to make revolutionary changes in established business practice in order to accommodate our work to these methods, and especially would this be so in the face of such opposition. Under all the circumstances, therefore, it is perhaps unfortunate that Mr. Fisher has asserted the superiority of his methods in quite such vigorous almost dogmatic terms, for it must be admitted that the recently proven variation in accident frequency with the extent of business activity is one bit of evidence which sharply brings to our attention the difference between the probabilities with which we deal and those upon which life insurance is based.

Mr. Fisher points out that in determining pure premiums by

the formula $\pi = L/P$ we are tacitly assuming that underlying the losses in the formula is a true loss probability as stable as the q_x of the mortality table, and that while we may not yet have sufficiently broad exposure to make our pure premiums found by this formula reflect this probability, it is only a question of time and some sort of graduation until we can do so. It seems to me that this fairly represents our attitude, and Mr. Fisher warns us that this may not be so, that we may find our underlying probability subject to violent perturbation. Have we not found it so in the recent boom times?

Mr. Fisher thinks that in the so-called Lexian-Charlier dispersion theory we have the infallible test of stability. Perhaps if we were all as familiar with that theory as he we would agree with him. Unfortunately we are not, and while he has given us one or two samples in explanation of the theory I, for one, hardly feel we are justified in assuming, therefore, that this theory does always accurately indicate whether or not the statistical series is stable and, if not, the probable extent of variation.

Mr. Fisher then proposes a system of compiling data and preparing rates consistent with such theories. If I correctly understand his suggestions he starts neither from industry classification as expressed in product, nor from hazard classification as expressed in separate process. He leans more to the latter, but taking the duties of the individual worker he would study the large number of separate occupations in modern industry and associate them in a small number of hazard groups. These he would establish, by the statistical tests he advocates, to be homogeneous, rearranging until he attained this result. He would then determine the pure premium for such groups and in determining the premium for individual risks do so by dividing the payroll to correspond to the hazard groups and applying the appropriate premium. He does not guarantee that even on this basis the probabilities in the hazard groups would be necessarily stable. Indeed it would seem that the disturbing force of boom times, such as above referred to, would be equally effective here.

In the note appended to his paper Mr. Fisher suggests rather than dividing the payroll and making the final rate on the risk that classification pure premiums might be developed by combining the separate hazard group pure premiums in the average proportion in which they occur in the several classifications. While this might avoid the necessity of dividing the payroll in writing the risks after the rates had been established, the work of division would be necessary as a preliminary in order to analyze and develop the first hazard groups, and in order to find the proportions in which they should be combined in building up the classification pure premium.

Personally, I have just enough curiosity so that I should like to see the plan tried out somewhere, but in the light of practical experience, and especially the earlier experience of my own company in attempting to use a plan of rating different from the established

tradition, I am convinced that a fair test cannot be made under competitive conditions. It is even a question in my mind whether a fair test could be made under monopolistic conditions. I am inclined to believe that the payroll division required by Mr. Fisher's method would rather run counter to the established and usual method of payroll accounting in manufacturing enterprises and, therefore, require that the manufacturer make special arrangements in order to furnish the data required by his insurance carrier. This would develop such an amount of opposition that it is even questionable whether under a monopolistic system of insurance the matter could be put through.

Despite the criticisms of these suggestions, Mr. Fisher deserves the thanks of the Society for bringing his suggestions before us. It is only through criticism and counter criticism that we will ultimately reach the point where our rate-making system neither sacrifices sound theory to practical considerations, nor imposes an unnecessary hardship for the purpose of satisfying theoretical conditions.

MR. ARNE FISHER:

(AUTHOR'S REVIEW OF DISCUSSION.)

Mr. Mowbray in his criticism of my little article seems to think that the collection of the statistical data along the lines I have suggested would offer serious obstacles in practice except under monopolistic conditions. Although his fears might be exaggerated, it is quite probable that this would be the case with private companies.

The point I wished to bring forward was, however, the need of systematic statistical methods in workmen's compensation assurance. It is here that the objections of Mr. Mowbray to objective mathematical methods somehow fall short of the mark. It is, I think, hardly fair to throw doubt upon the practical value of the Lexian-Charlier dispersion theory just because the majority of statisticians and university instructors in this country are not familiar with this theory. A student who never had gone beyond the study of elementary algebra would certainly not be justified in belittling the very practical value of the infinitesimal calculus just because he did not know its method or theory.

I admit that we have other means than the Lexian-Charlier method to test the perturbations in a statistical series, and I should indeed have welcomed them if the reviewer had mentioned such methods or suggested one of his own. His fear as to the practical utility of the method because of the fact that I have only given three or four practical illustrations of its use in my previous writings seems to me to be of no weight. The validity of method is certainly not established by the number of illustrative examples. Moreover, it would be out of the question to give, say, several hundred illustrations of the use of the method in my recent treatise on "Probabilities" where, besides introducing this particular method, I had

to demonstrate and illustrate a large number of quite different theorems. To allay all doubts, I may say, however, that I use the method almost daily in my routine statistical work and have found it satisfactory.

Referring to minor points of the review it is probably true I have been too dogmatic in my style of writing. I felt, however, one had to be forcible, even if running the danger of being called dogmatic, in order to obtain a hearing.

Taken as a whole, many of Mr. Mowbray's comments have served to strengthen rather than to diminish my contention that systematic statistical methods not only are lacking, but are sadly needed in accident statistics. The very fact that Mr. Mowbray himself admits that statistical series in workmen's compensation are subject to perturbations in boom times would, I think, encourage one to a further study of various methods of testing statistical variation, rather than to ignore the real and practical value of mathematical statistics.

ON THE RELATION OF ACCIDENT FREQUENCY TO BUSINESS ACTIVITY —A. H. MOWBRAY AND S. B. BLACK, D. S. BEYER CO-OPERATING.

VOL. II, PAGE 418.

ORAL DISCUSSION.

MR. ALBERT H. MOWBRAY: Although no one here seems to want to discuss this paper, I desire to call attention to the fact that it has been much discussed in the columns of *The Economic World.* Mr. Arthur R. Marsh, the editor of *The Economic World,* criticized certain statements made by Mr. F. Spencer Baldwin respecting the experience of the New York State Insurance Fund, and Mr. Baldwin in his reply cited this paper in support of his contention. In publishing the letter Mr. Marsh appended some editorial comments in which he makes some remarks about the paper, and unless some member of the Society cares to offer a further discussion, I would like, in a measure, to close the discussion by replying to Mr. Marsh's criticism.

Mr. Marsh, in his usual excellent literary style, remarks that he was not a little irritated by the solemnity with which Messrs. Mowbray and Black proceed to draw conclusions from American experience which, after all, is worth very little. He then points out the general tendency in European countries toward an upward trend, and he points out by implication rather than direct statement that what we call attention to is, after all, nothing more than that upward trend, and that the extra business pressure of the present time is not to be considered the cause of the increase. He makes some general observations of an *a priori* character of the reasons assigned for this increase.

With all due respect for the material which Mr. Marsh brings forward from European countries, it seems to me that Mr. Marsh has missed entirely the point of the paper. The important fact brought out, it seems to me, was the decrease between the two periods.

Now, I would grant that in observing social phenomena we are not so fortunate as the engineer dealing with physical facts in that we can estimate our causes. We cannot do it. We have simply to consider the results over two periods, and then consider the complex of causes operating during those two periods, and use our best judgment in picking out what we consider to be the dominant causes.

We had two periods there, and in the latter of the two we had a thirteen per cent. reduction in the accident frequency. It seems to

us that the dominant causes of the difference between those two periods was the fact that the second period was one of greatly reduced industrial activity, due to the occurrence of the European War, and to that we attributed the decrease in accident frequency. And after that the subsequent increase which we observed after the present pressure began was attributed in part to the introduction of new employees. In that connection Mr. Marsh calls attention to the adage that familiarity breeds contempt and suggests that the new employee might be better with respect to safety than the older employees. That may be true, but I think there is another factor which comes in, and that is that the new employees are not of the same quality and calibre as the old employees, and that the new employees introduced are less well trained and less capable.

It may be interesting to members of the Society to know that I was talking recently with an underwriter of a company in Boston about this matter, and he remarked that his company had found a very curious condition. They had found a rapid increase in the accidents in the case of certain of their insureds, and the increase seemed to be in the plants in the neighborhood of Boston. He practically said that he was more or less at a loss to account for it, although he said he believed that possibly one reason was that the natural trend of migration was to take the skilled and trained workers away from the metropolitan centers out into the western part of the state, and new employees had to be introduced in the metropolitan centers.

Editor's Note.

The discussion referred to by Mr. Mowbray appears in the following issues of *The Economic World.*

October 21, 1916, p. 535. Letter from Mr. F. Spencer Baldwin and note thereon by the editor of *The Economic World.*

October 28, 1916, p. 568. "The Encouraging Downward Tendency of the General and the Industrial Accident Mortality Rate in the United States" by Mr. Frederick L. Hoffman.

November 4, 1916, p. 598. Letter from Mr. F. Spencer Baldwin and editorial in reply.

November 18, 1916, p. 662. Letters from Messrs. Albert H. Mowbray and Frederick L. Hoffman.

OFFICE PRACTICE IN THE VALUATION OF COMPENSATION LOSSES—RICHARD FONDILLER.

VOL. II, PAGE 427.

WRITTEN DISCUSSION.

MR. WILLIAM LESLIE:

This paper is a praiseworthy contribution in the domain of practical rather than theoretical problems. The methods outlined are undoubtedly clear and in the case of the New York State Insurance Fund appear to be practical and to permit of rapid application. It would seem to me, however, that a method of group valuation, as suggested by Mr. Dawson at page 99 in his article entitled "Workmen's Compensation Claim Reserves" (*Proceedings,* Vol. I, p. 90), would be preferable in the case of temporary disabilities.

The principal objection which might be raised to Mr. Fondiller's system, is that it involves more detail than a company with a large business could afford to devote to this work. This is true only as respects temporary disability cases because the deaths, permanents and dismemberments constitute only a small proportion of the cases open on any valuation date, and individually estimating them is not arduous. The method of grouping all open temporary cases of the same duration and multiplying the aggregate amount by the proper reserve factor would reduce the labor involved to an amount which even a company with a large business could consider reasonable. Inasmuch as the reserve per case of temporary disability is established on the basis of the average cost of disabilities of the same duration and, as pointed out under the heading of "Lump Sum Settlements," is probably more or less than the true cost of the individual case, there seems to be no particular demand for an individual case reserve.

A system of computing the reserve for temporary disabilities on an average cost per case method without regard to duration would of course be much simpler and would involve much less work. If the table used by the New York State Insurance Fund in valuing temporary disabilities is accurate, then it gives much truer results than could be obtained by the average cost per case system under any circumstances. The table used reflects the distribution of accidents by severity as well as by number, whereas an average cost per case method takes into account only the number. From one valuation period to another the character of risks insured may vary to such an extent as to change materially the average cost per case of temporary disabilities. Whether the objection is sufficient to over-

come the greater simplicity of an average cost per case system depends upon other factors such as the amount of business insured, the number of valuations required during the year, the purpose of the valuations and the laws of the various states in which business is transacted.

For an institution doing business only in one state and handling only one line, the method is quite adaptable. Yet even then the work it involves may be unwarranted. For example, the California laws require a reserve of 75 per cent. of earned premiums less losses and loss expenses actually paid, without any comparison, for the two years immediately preceding the date of valuation, with the estimated cost of claims. For financial statements the reserve must be established according to the requirements of the reserve law and the plan described by Mr. Fondiller would be of value only as an analysis of the business for the purpose of determining adequacy of rates or the "hidden" profit or loss on underwriting. In such an analysis, over estimates of incurred losses are just as misleading as under estimates, though perhaps of a less harmful character. The table for valuing temporary disabilities would, therefore, have to be known to be reasonably accurate before its use could be justified for such purposes. At the present time, compensation statistics are so incomplete that this is impossible and it might be preferable to apply a simpler method of attaining results, which would probably represent just as closely the true incurred losses under temporary disability cases.

I am, however, a firm believer in a system of reserving, either for financial statements or for purposes of cost analysis, which eliminates the personal element in estimating incurred losses and substitutes a procedure, mechanical in its operation. Theoretically, I believe in the soundness of the plan outlined by Mr. Fondiller. Practically I doubt its adaptability in many offices, first because of the volume of business transacted and second because of the inability at this time to construct a table which is accurate enough to warrant a company undergoing the expense of this method of determining incurred losses.

Where this particular system of reserving is prescribed by law or by the rules of the state insurance department, the office procedure could, I believe, be simplified by the introduction of the Hollerith or Pierce Punch Card system, combined with the above suggested method of group valuation.

MR. JOHN L. TRAIN:

Mutual compensation companies are particularly interested in the paper of Mr. Fondiller in view of the fact that Chapter 832 of the Laws of 1913 (New York Insurance Law, § 191), which permitted the transaction of compensation insurance in New York State by mutual companies, contained the following provision as to reserves:

"Reserves for liability for insurance of compensation under the workmen's compensation law shall be the same reserves as provided by the workmen's compensation commission for the state insurance fund."

By Chapter 506 of the Laws of 1915, this section was amended as follows:

"Reserves for liability for insurance of compensation under the workmen's compensation law shall be prescribed by the superintendent of insurance."

The system of reserves prescribed by the Superintendent of Insurance is practically the same as that adopted by the State Insurance Fund.

The loss reserves maintained by mutual companies are computed in the same manner as outlined in the paper under discussion except as to suspended mortality. A reserve for this item is set up by the State Insurance Fund for an amount equal to one-eighth of the non-fatal cases. I believe that there is sufficient excess reserve in the temporary total disability cases to take care of this suspended mortality, provided the insurance carrier has a sufficient amount of business so as to have outstanding enough temporary total disability cases to permit the absorption of at least two deaths. During the last two years, our company has not had a single death arising from claims originally reserved on the basis of temporary total disability. Further, the actual losses carried to maturity have not exceeded 80 per cent. of the total reserve. As the loss reserve for specific injuries and death is a specific amount, the gain, therefore, has come entirely from the temporary total disability cases. The extra 20 per cent. would take care of the average number of deaths that might arise from that class of cases. From the various tests of this reserve made during the past two years, we are convinced that the reserve resulting from the application of this system is at least adequate, even without setting aside any reserve for suspended mortality.

I agree with Mr. Fondiller that the method of computing loss reserves as followed by the State Insurance Fund and the mutual companies could be applied to the business of all insurance carriers writing workmen's compensation in any state. Every company undoubtedly estimates its outstanding compensation losses. In making such estimates, it is not difficult to arrive at the loss reserve for death and specific injuries. The only troublesome factor is as to the amount of reserve to be applied to the temporary total disability cases, which constitute the greatest proportion of the outstanding claims. The reserve for this class of cases should be sufficiently high not only to take care of the claim department's opinion as to the individual cases but also to have an excess to take care of more serious losses that eventually arise out of this character of claims. In this state, the reserve for each temporary total disability claim arising within six months prior of the valuation, is $75.00

plus $30.00 for medical cost. Based on this amount, a reserve for this class of cases in other states could be arrived at without any great difficulty. This method, of course, would require every company to segregate its losses by states, and a number of the companies follow this method at the present time. The strongest feature of such a system of loss reserves is that it is really a loss reserve and not a premium reserve. A company that has a bad loss experience must maintain a high loss reserve which may exceed, and oftentimes will, the fixed percentage of the premiums as provided in the present insurance law and also as in the contemplated amendments to such law as proposed by the Convention of Insurance Commissioners.

Our company computes its loss reserve every month and under this method, one man can compute such reserves in less than two days. Not only is it a short method but we are convinced that the reserve required to be maintained is at least adequate to pay the losses. It would seem that the method outlined by Mr. Fondiller is a sound basis for a real workmen's compensation loss reserve that is scientific, at least adequate, and will show what a loss reserve is intended to show, the actual loss ratio of the company.

ORAL DISCUSSION.

MR. HARWOOD E. RYAN: I am very much interested in Mr. Train's discussion, because he has had to apply this method in the case of his own company, but I must confess that I think he is mistaken in regard to the ease with which the method may be applied to a large volume of interstate business. Anybody who has had to deal with the problem of state differentials will appreciate how difficult it is to satisfactorily determine on the basis of available statistics what shall be the differential factor to apply against each type of claim in order to arrive at suitable reserve values for a company doing a country-wide business.

It may be of interest to this gathering to know that a movement is on foot to seek the co-operation of the insurance companies with respect to a study of their compensation claims for the purpose of determining what the values should be in actual practice as distinguished from the values applied on a more or less theoretical basis by the mutual companies of New York State and by the State Insurance Fund. Commencing with the year 1911 and following, the losses incurred in the various workmen's compensation states down to their termination, say, at the end of 1915, there is already in the files of many of the companies information which would afford a basis for an accurate classification of accidents, along with their ultimate cost; and while the method described by Mr. Fondiller has presumably produced satisfactory results up to the present time, there is a very decided need for a revision of our accident figures so that tables may be based on experience under American

conditions rather than on the experience of European countries, which really is the fundamental basis of the present reserve system.

Another point of interest is that a committee of insurance commissioners which has been dealing with the subject of loss reserves for workmen's compensation insurance during the past week has again enunciated the belief that a satisfactory test of solvency for insurance companies doing this class of business is to be found in the application of the percentage reserve. The present New York law, which is the law existing in various other states, prescribes for the year 1916 and subsequent years, a maximum reserve of 55 per cent. of the earned premiums, less paid losses and loss expenses. The insurance commissioners have decided that this is an inadequate percentage and that it should be changed to a maximum of 65 per cent.

From the actuarial point of view, the percentage method is indefensible since it proceeds from assumptions which may be, and frequently are, wide of the facts. No method of reserving which ignores the nature of the obligation incurred and is based upon so unstable a quantity as the premium charged for workmen's compensation insurance, can appeal to the actuary as being suitable and trustworthy. Entirely apart, however, from the merely mechanical advantages of applying the percentage method, it may be fairly argued, from the viewpoint of an insurance department whose duty it is to see that the legal reserve requirements are complied with, that unless the reserve is determined with reference to the premium, the department has no means of ascertaining whether the reserve is in accordance with the provisions of law unless it makes an examination of the company's records. The department cannot, however, be continually examining a given company and yet without such examination it cannot be certain that the reserves erected by it are adequate and in accordance with law, unless the method by which the reserves are calculated affords a means of verification through accounting control. This, to my mind, is the greatest weakness of the individual estimate or "case" method, whether the reserve be based upon tabular values or upon estimates furnished by the claim department. The insurance department must accept the reserves reported by the company and in the interval between examinations, has no means of knowing whether reserves have been set up to cover all outstanding obligations. The alternative would seem to be an application of the percentage method which would recognize the necessity for a high percentage as the test of solvency and which would provide for the maintenance of rates that would be adequate to meet such a test. At the same time, I must admit that the case method, being correct in principle, must ultimately prevail and that our attention should be directed to methods of obviating some of the difficulties which now attend its practical application.

MR. RICHARD FONDILLER:

(AUTHOR'S REVIEW OF DISCUSSIONS.)

I am much indebted to Mr. Leslie and to Mr. Train for their clear discussions of my paper.

Mr. Leslie's remark that Mr. Dawson's method of group valuation would be preferable is ably answered by Mr. Woodward in his discussion of Mr. Dawson's paper in Vol. I, p. 143, et seq.

I cannot share Mr. Leslie's doubts as to the expense involved in the detail of carrying out the methods outlined in my paper. The plan has been in successful operation for over two years. The valuation of losses is historically a function of the claim department, and, as has been frequently remarked, the claim adjuster will almost invariably underestimate losses. The system outlined in my paper is applied in the actuarial department, where such work logically belongs, just as the valuation of the outstanding business of life insurance companies is performed in their actuarial departments. The ease and rapidity with which a valuation is completed by employees who have been trained in the department, together with the low cost, surprises those who are not familiar with the system.

The accident history cards are used for the several purposes of (1) the valuation of the claim liabilities of the Fund as a whole; (2) for the valuation of experience under manual classifications; (3) for the allocation of losses to the statutory group in which they fall, as a necessary element in the work of the declaration of dividends; (4) to secure the experience of individual employers. The tabulation of the incurred loss with the elements of reserve for compensation, suspended mortality, compensation past due, and medical, permit of summaries being made for any of the purposes previously mentioned and also at any valuation date that may be selected.

From Mr. Leslie's point that my method is adaptable for an institution doing business in only one state and handling only one line, it might be inferred that in general it can only be successfully used by a company of moderate size. It is interesting to note in this connection that the annual premium income of the New York State Insurance Fund, comparatively speaking, is large. The adaptation of my method to the various state laws is merely a matter of office detail. The use of the Hollerith system would materially diminish the usefulness of the system, for the reason that there are numerous changes due to posting, that the cards are handled for the various purposes outlined above and are used by men who are not familiar with the Hollerith system.

I have been much interested in Mr. Train's discussion of my paper and it is not surprising that, under the limited exposure of his company, no deaths have yet arisen out of claims originally

reserved for on the basis of temporary total disability. In the experience of the Fund, involving over 36,000 notices of accident, there have been five deaths arising out of claims originally classed as temporary total disability, and it is to provide for this item that a reserve has been established under the head of suspended mortality. It is gratifying to observe that Mr. Train agrees unqualifiedly with my statement that these methods are applicable to the business of all insurance carriers writing workmen's compensation in any state.

With our increasing experience, it has been found necessary to make only two valuations a year of all accident notices received during the preceding calendar year. Thus, the valuation on December 31, 1916, will involve the detail only of the accidents occurring during the calendar year 1916. Out of all the accidents occurring prior to December 31, 1915, there will be less than 300 cases (the majority of them being death claims) outstanding as of December 31, 1916, which will be revalued.