VOLUME IV, PART I NUMBER 9

PROCEEDINGS

OF

The Casualty Actuarial and Statistical Society of America

OCTOBER 31 AND NOVEMBER 1, 1917

SUBSCRIPTIONS TO THE PROCEEDINGS

Volume I consists of Numbers 1, 2 and 3, price $3.00.
Volume II consists of Numbers 4, 5 and 6, price $3.00.
Volume III consists of Numbers 7 and 8, price $2.00.
The above volumes are bound in buckram. Any number may be purchased at $1.00 per copy. The subscription rate for Volume IV, which will consist of Numbers 9 and 10, is $2.00.

Communications should be addressed to

RICHARD FONDILLER, *Editor,*

CASUALTY ACTUARIAL AND STATISTICAL SOCIETY,
230 FIFTH AVENUE, NEW YORK.

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PRESS OF
THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

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NOTICE.

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VOLUME IV, PART I. NUMBER 9.

PROCEEDINGS

OCTOBER 31 and NOVEMBER 1, 1917.

THE WAR INSURANCE ACT.

ADDRESS OF THE PRESIDENT, JAMES D. CRAIG.

The six months which have elapsed since our last meeting have been momentous ones. The complications and hazards in all the branches of insurance with which we are so deeply concerned have increased, and all of us have been sobered by our enlarged responsibilities. The largest insurance proposition ever considered has been adopted by the United States government in the form of its war insurance Act. The appropriation for the first year as apportioned by Congress under Sections 17, 18, 19 and 20 of the "Act to authorize the establishment of a Bureau of War Risk Insurance in the Treasury Department" is $176,250,000. For the second year it has been estimated that the cost will be over $380,000,000, contingent, of course, upon the war lasting through that year. To the above sums must be added the premiums to be paid by the men in the service themselves. On the basis of a million men the first year, each insured for the maximum sum of $10,000 at a premium approximating $80, the aggregate premium would be $80,000,000. A few years ago, before we were educated to talk in hundred millions, and even billions, such figures would have staggered us.

The benefits provided were decided upon after a number of conferences with insurance experts, much of whose advice was followed. It must be a source of gratification to the members of this Society to know that the estimate of costs for the first and second years, as already given, was largely prepared by a Committee of Five, of which your President and one of your Vice-Presidents were members, while both of your Vice-Presidents have recently been working for the government on actuarial problems involved in other provisions of the Act. In addition to these, several of our

members have rendered great assistance to the government. One has been appointed a captain in the Army, assigned to the Treasury Department and has had an important part in the whole proceedings. While we would enjoy his presence at this meeting, we are glad to know his absence is the result of a call to France in connection with this government insurance.

In addition to family allowances which are simply conditional increases in salary, payable to various members of the soldier's family, the benefits provided under the Act follow, in general, both compensation and life insurance, although, strictly speaking, they are neither. Under compensation insurance the object is to indemnify an employee, in so far as it is practicable, for losses incurred in the industry through death or through partial or total disability. Such indemnity must consequently be based upon the loss, and is solely a function of the earning capacity. The government Act recognizes compensation principles in so far as it endeavors to indemnify against death and total or partial disability resulting in the performance of duty while in the employ of the government, also in making the benefits contingent upon the number and relationship of dependents, but ignores the principle of making this indemnity a function of the earning power. It was originally proposed to make the benefits contingent somewhat upon the remuneration paid by the government, but Congress eliminated this feature and provided uniform amounts, irrespective of the pay, so that the compensation allowed to the widow of a major is the same as that allowed the widow of a private. The financial loss incurred by men joining the Army or Navy is not measured by the pay allowed by the government, and the actual loss from death or disability incurred by different men is not attempted to be gauged by the benefits granted.

Under the life-insurance part of the Act the benefit payable in installments in event of either death or total disability is in reality an additional compensation benefit granted by the government, in accordance with the usual basic principles of Workmen's Compensation, conditioned upon the employees paying part of the cost. In fact, Section 400 of Article IV of the Act commences:

"That in order to give to every commissioned officer and enlisted man . . . greater protection . . . than is provided in Article III, the United States . . . shall grant insurance against the death or total permanent disability of any such person . . . upon the payment of the premiums as hereinafter provided."

"The premiums as hereinafter provided" do not in all probability represent the entire cost, and under Section 20 the government appropriated $23,000,000. The risk covered being so largely an occupational hazard of the most hazardous degree, with by far the larger proportion of the probable cost borne by the government, ought to be considered as part of the indemnities granted.

In the discussion prior to the passage of this Act, numerous criticisms were made, particularly against Article IV dealing with insurance. Those parts of the Act relating to allotments of pay, family allowances and compensation for death or disability were generally looked upon as valuable and constructive contributions to the great problem of the care of dependents, but there were serious and fundamental objections to certain features of the insurance part, and, unfortunately, when these were pointed out, attempts were made to divert the issue by endeavoring to make it appear that the insurance companies were antagonistic to the bill. We, as actuaries and statisticians, know this was not so. Can we not state here to the credit of those identified with company interests that they absolutely put behind them every thought of personal or company advantage, pointing out only those objections to the Act which should have been pointed out for the good of insurance, as well as for its continued development, and offering only those suggestions which were deemed to be for the general good.

In brief, it was pointed out that if the compensation benefits were not sufficient, they should be made so, while if they were ample, no further benefits were needed. In any event, no benefits should be offered under which discrimination was allowed in favor of those who were well able to protect themselves and which absolutely ignored those less able to pay. Other criticisms related to the loss of the insurance, unless applied for within 120 days, and to the forfeiture of the insurance in certain cases to the government.

This Act brings about a situation in government insurance quite the opposite from that to which private companies are accustomed. Throughout the country supervisory legislation is being enacted every year for the protection of policyholders, guarding their interests in almost all conceivable ways, not even permitting any contract to be issued without the express approval of the Insurance Department.

In this Act, however, the safeguards usually demanded of private companies have been given comparatively little consideration and the whole matter has virtually been placed in the hands of two officials.

Section 402 of the Act states:

"That the Director, subject to the general direction of the Secretary of the Treasury, shall promptly determine upon and publish the full and exact terms and conditions of such contract of insurance."

When it is considered that an army of 2,000,000 men insured for $10,000 each makes an aggregate of $20,000,000,000 and that this is three fourths as much as the total insurance now in force in the entire United States in all life insurance companies combined, the power vested in one or two individuals is apparent.

The contrast between the supervision of a state over private insurance companies and the practice when a state enters the insurance business itself is not entirely new to us. The state of Wisconsin ignores its own insurance laws generally in connection with its own state insurance funds.

In favor of the Act, it was contended that the American soldiers as American citizens should be encouraged in private initiative, in self-help and self-reliance, and be stimulated to safeguard themselves against the inevitable things in the life of every man and not merely in the life of the soldier fighting for his country; also, that they should not be deprived of the power of making payment out of their pockets for their own protection in the future, and that there was not a single private in the war who could not afford, if he wished it, to take $10,000 of insurance at the rate offered, to contribute to the support of his family and still have enough left for spending money in France.

The general criticism against placing excessive authority in one place has also been lodged against that part of Section 302 relating to partial disability, where the schedule of ratings as to the reduction in earning capacity is both adopted and applied by the bureau in charge. Under compensation insurance the awards are usually made by independent bodies or state commissions, but in this government Act the entire matter of preparing a schedule and of then applying it all rests in the same body with appeal only to the courts.

Under Section 302 where provision is made for total disability

various amounts of monthly compensation are given based upon the dependents, after which it expressly provides that certain particular disablements shall receive a flat compensation of $100 per month. There is apparently no good reason why certain particular disablements should receive this special consideration. If compensation is granted in event of total disability, it ought to be sufficient to provide for all forms, and it is very probable that the clause as it reads, allowing $100 a month, will largely nullify the specific benefits enumerated, because, after provision for "the loss of both feet, both hands or both eyes, or becoming totally blind," the words "or helpless" are included as one of the conditions under which $100 a month shall be granted, and any strict construction of the law will probably hold that in any case of total disability, the soldier was helpless.

The vastness of this whole undertaking, both of compensation and insurance, combined with its general uncertainty, should make for conservatism and an endeavor to reduce the uncertainties to a minimum. It was suggested that the indemnities paid on the compensation basis be increased in value by $1,000, $2,000 or even $4,000 or $5,000 and be made to apply to everyone, in place of the optional insurance. This suggestion was not accepted. In preparing its actuarial report the Committee stated:

"The net amount payable by the government for the year ending September 1, 1918, would be $46,000,000, if 25 per cent. of the men were covered for $5,000 each."

It was subsequently thought that 25 per cent. of the men would take not more than $2,500 of insurance and Congress therefore apportioned $23,000,000, instead of $46,000,000. Which is the nearer figure we do not know, but as far as we are able to discern from the present published returns, the majority of the men seem to be applying for the maximum of $10,000. In the *New York Times* of October 24, 1917, the statement was made that twenty-seven applications had been received from the members of a single company for $10,000 each, while in the *Economic World* of October 20, 1917, we read:

"The officers and men gathered at Camp Mills, N. Y., for example, are stated to have applied for the insurance virtually without a single exception, and, except in a trivial number of cases, for the maximum amount allowed, $10,000."

In the *Bulletin of the War Study Society* of August 1, 1916, it is stated that France has had 885,000 men killed in the war and 2,115,000 wounded, of whom 634,000 are invalids, and it might be well to reflect upon the ultimate cost to this government if the war lasts long enough to cause any such losses. The loss from the sinking of the Antilles on its return voyage, with relatively few persons on board, will probably run into hundreds of thousands of dollars.

One fact stands out prominently. The importance and the indispensability of insurance has been officially recognized by the United States government. In the address of Hon. W. G. McAdoo, Secretary of the Treasury, delivered at the Annual Convention of the American Bankers' Association, at Atlantic City, N. J., September 28, 1917, is the following:

"When war comes to a nation the first essential is money. We must keep our soldiers and sailors armed and equipped with the best that money can buy and American skill devise. We must constantly provide them with necessary clothing and food; we must pay their wages; we must, as a humane and just Nation, support their dependent families while they are risking and giving their very lives for us; we must supply them with a reasonable amount of life insurance."

Here the support of families and life insurance is considered in the same breath with equipment, clothing and food. Immediately after the paragraph just quoted follows an argument in favor of insurance. In this argument it is stated that when a nation reaches out and takes a man, in addition to conscripting part of his income and compelling him to leave his home, it also destroys the insurability of that man. Here we have an official expression of the high estate of insurance. It is not sufficient that a man be equipped and that he be clothed; he must also be insured. It is permissible to conscript his resources and to take him away from home and family, but his insurability must not be destroyed. Surely we can feel proud of our business and of its efficiency when, in these strenuous days of war, the governing officials feel constrained to consider it just as essential as the more spectacular necessities of arms and ammunition.

It is not possible at this early date to enter into a full discussion of the measure, but the above outline of some of the activities of the last six months has been drawn to your attention in order that

you may be more fully cognizant of the part your officers and fellows are taking and in the hope that if opportunity presents itself, you will at all times offer your services with at least a full realization of the immensity of the contract with which you are dealing and with the knowledge that, as members of the Casualty Actuarial and Statistical Society of America, you have had special training which should enable you to cope with large problems.

THE THEORY AND PRACTICE OF LAW DIFFERENTIALS.

BY

I. M. RUBINOW.

INTRODUCTION.

The principle of law differentials in its application to the computation of compensation rates needs no defense at this time. It has proven itself almost indispensable in meeting the practical problems of compensation insurance at the time of the introduction of every new law, and is still of great help in those states where compensation laws have been in force for some years, and local experience has been accumulating.

When the method was devised, the situation in compensation insurance was very critical indeed, and it is difficult to speculate as to what the development would have been if some objective method, independent of crude underwriting judgment and competitive underbidding, had not been devised—a method which immediately achieved well nigh universal confidence, not because of any claim at infallibility but because of convincing proof of honesty in its application.

It is well to remember that the method was devised under pressure of immediate demands of the moment, and that the details of the application of the method suffered, even more than the principle itself, because of many limitations of doing a piece of scientific work under conditions of an acute business situation. Moreover, it was admitted at the time by those who were directly engaged in the elaboration of the principle, that in the form in which it was originally applied it was but a crude approximation which would require numerous refinements in the near future. As more than three years have passed since the first application of the law differential based upon the Standard Accident Table, and since comparatively few changes have been introduced in the method of its application, the time seems ripe for a careful examination of the entire method, to discover the true uses, its necessary limitations, the possible sources of error, and available methods for their elimination.

Historic Note.

It is a curious fact that with its thirty years of compensation experience, European insurance practice did not, as far as the present writer is aware of, develop the method of differentials. To be sure, the necessity for any such method was very much less felt, in fact may be said to be lacking altogether. The need of law differentials arose out of the multiplicity of laws, resulting from our peculiar political constitutions. Since European acts are national in their scope, there is no necessity for local law differentiations. Of course, at the time of the introduction of the compensation legislation, many a European country might have profited considerably and perhaps avoided a good many pitfalls, if it had the method of law differentials at its disposal and thus could make use of the loss experience of other countries for the computation of its own rates. Perhaps the failure to do so may be explained by the fact that the pay-as-you-go method of German compensation insurance, and the futility of the Austrian efforts to provide sufficient reserves, made the utilization of the experience of both those countries impossible for the other countries. Moreover, the differences in the industrial conditions of the different countries prevented any feeling of security in dependency upon the experience of foreign countries in the entire matter of compensation costs.

The method might have proven more useful for a different purpose, for which it has been used very largely in this country—namely, the adjustment of rates to changes in the benefit scale. Of course such changes have taken place in European legislation as well, though perhaps not as frequently as in this country. But for some reason, neither any standard accident table, nor, what is more important, the principle upon which the Standard Accident Table is based, has been promulgated until 1914. A proper adjustment of rates to a change in a benefit scale is a matter of minor importance where assessment insurance prevails, as in Germany, or other forms of mutual insurance. And stock insurance, which, more than any other form, needs a scientific basis for rate-making, is but slightly developed in this field of insurance in most European countries. When stock insurance does exist the conditions of rate control are absent altogether, competition in rates is permitted, and in the adjustment of rates to the varying requirements of the business, European stock insurance companies in this field

were evidently depending largely upon crude underwriting impressions.

The Underlying Principle.—What, briefly, is the actuarial principle involved in the system of law differentials? It is that—other things being equal—the cost of compensation, and therefore the level of compensation premiums, under different acts must be in proportion to the benefit scales provided, so that if the benefits under Act B were twice as liberal as those under Act A, the rates should also be twice as high. While the above observation is altogether obvious, opinions may differ as to the best method of ascertaining this difference between benefit scales of different laws. Recently this question assumed the form of controversy between the "experience method" and the "valuation method" which might be called respectively the retrospective and prospective method of computing the relationship between two or more acts. The respective merits of the two methods will be compared presently, but it is evident that the experience method at best is only available after a sufficient amount of time has elapsed since the act went into effect, and that for new acts, which was the problem in 1914, some prospective method became inevitable. What is the fundamental thought of this prospective method?

If all the accidents were of the same quality, or if the differences in the scale of benefit were perfectly uniform for all the kinds of accidents, the problems would have been comparatively simple. But in actual practice the situation is very much more complex, because there are so many different kinds of accidents and so many different standards of liberality in compensating these different kinds of accidents. The first effort to compare the cost of two acts which differed in a great many details, namely, the Massachusetts Act of 1911 and the New York Act of 1913, disclosed so many uncertainties that one was tempted to give up in despair, until the Standard Accident Table provided a convenient yardstick.

It is only fair to point out that before the Standard Accident Table was prepared, an effort was made to compute differentials for a limited number of states by Dr. E. H. Downey and Mr. S. Bruce Black, then both of the Wisconsin Industrial Commission. The claim was not made, however, at the time that the results may be utilized for purposes of rate-making. It was largely a comparison of "the various state compensation acts as they affect the workingman."

A common laborer, earning $2 a day, aged 30, with a wife aged 28 and four children aged 2, 6, 8, and 10, was taken as standard. By this method the effect of many differences in compensation scales was disregarded, the cost of medical aid was altogether omitted, and the accident experience for two years in the state of Wisconsin was the basis of computation. It is, perhaps, important to add that notwithstanding the many crudities of this method, the results were not so hopelessly different from those later obtained by the Actuarial Committee of the National Workmen's Compensation Service Bureau, the only serious difference being in the case of the Illinois differential. Dr. Downey has called my attention to the fact that the Wisconsin differential referred to the Illinois Act of 1911, and the Bureau differential to the Illinois Act of 1913, so that even in this case the discrepancy is only a seeming one.

States.	Wisconsin Differential.	Workmen's Compensation Bureau.	Converted to Wisconsin Basis.
Wisconsin	100	150	100
Illinois	79	137	91
Iowa	68	104	69
Michigan	69	104	69
Minnesota	75	115	77

The Wisconsin computation proceeded from the following reasoning. All the 13,463 accidents which were compensated for in Wisconsin, if compensated under the Minnesota scale, would have cost 75 per cent. of what they did cost in Wisconsin. Evidently this would not hold true if, for instance, only fatal accidents were taken because the relative cost of the 268 fatal accidents under the various scales was as follows:

		Fatality Differential.	General Differential.
Wisconsin	$364,495	100	100
Illinois	359,670	96	79
Iowa	282,951	78	68
Michigan	277,216	76	69
Minnesota	317,888	87	75

Would the same relationship also hold true if individual classifications were taken? This question was not raised in the Wisconsin report because, as already stated, its problem was not the problem of rate-making, but only the problem of comparative liberality of acts. An affirmative answer was given to this question by the

Differential Committee 1914. But in justice to the Committee it must be stated that this affirmative answer was not a matter of conviction, but only of expediency. In my first paper on the "Scientific Methods of Computing Compensation Rates" (*Proceedings,* Vol. I, p. 10), the theoretical inadequacy of such an affirmative answer was very frankly admitted and it was stated then that "theoretically different standard accident tables should be compiled for each classification or at least for each large industrial group. We may feel that we have accomplished a good deal in achieving justice as between one state and another, without claiming equal justice between classifications."

In other words, it was recognized that the varying differentials of different accident classes made some method of weighting these differentials imperative, and some assumed distribution of accidents according to gravity was necessary, in order to offer some basis for this weighting. For this purpose the Standard Accident Table was prepared.

It may be recognized that the Standard Accident Table at that time saved the situation for the entire compensation business. The table proved even more useful and enduring than its compiler had dared to hope at the time. Official sanction was given to it on December 3, 1915, when the Joint Conference by a unanimous vote adopted the recommendation of the Committee on Loading and Differentials that "a valuation upon the Standard Accident Table at present affords the best basis for the computation of law differentials," and the propriety of applying a uniform law differential was not even questioned. Another year of experience raised several questions, but nevertheless for various reasons, the Actuarial Committee of the Standing Committee on Compensation Rates, as late as February of the current year, resolved that "the system of single law differential adopted at the last Conference be reaffirmed."

This steadfast adherence to the method must prove a source of great satisfaction to everyone who has been more or less identified with the elaboration of the original method. Nevertheless, a frank recognition of the provisional character of that method as suggested in 1914, and the accumulation of a vast amount of experience since then, makes at this time a careful reconsideration of the entire differential method highly desirable if not imperative. And it is hoped that no prejudice or bias will be charged against this criticism emanating from one of the three members of the original Differential Committee.

Has the differential method proven universally applicable? The increasing number of exceptions in the rate sheets of the various states seems to point out that under certain conditions the differential method is either inapplicable or unnecessary.

"Dr. Rubinow will perhaps agree with the statement that in this country with the many different state systems of workmen's compensation and the diversity of constructions adopted in administering the laws, the law differential will soon have to give way to experience in the determination of rates," says Mr. Ryan (*Proceedings,* Vol. II, p. 264).

I am, unfortunately, unable to agree with this statement without some substantial qualifications. Experience alone, without modification by means of law differentials, means experience of one state only, and to be a sufficient guide for rate-making, must be sufficiently broad. How broad it must be, *i. e.,* specifically how large the payroll exposure must be, is a question that has been carefully considered by the ablest mathematicians of this Society,* but as yet no scientifically accurate answer has been given, beyond Mr. Mowbray's statement, that "it will become more and more important to have clearly in mind some standard of exposure to be considered dependable."†

It would seem clear, however, even to the non-mathematical mind, that the mathematical effort is directed towards ascertaining the minimum dependable exposure; that the increase of the exposure beyond that minimum cannot make it less dependable; and that, therefore, without mathematical accuracy a dependable exposure must sometimes be reached in specific classifications of certain states. It is also generally admitted that the necessary exposure varies inversely to the premium level, or which is the same thing, that we may speak of the dependable exposure in terms of premium rather than payroll. Until the mathematicians agree, an empirical formula may prove useful, especially since the fluctuations in the pure premium below a certain percentage are of little importance. A very crude empirical formula was suggested in my paper three years ago. "Only then may we begin to speak of a dependable experience when at least one accident will not seriously disturb the average pure premium."‡ Suppose we grant that a

* Mowbray, *Proceedings,* Vol. I, pp. 24–30; Fisher, *Proceedings,* Vol. II, p. 276.

† *Proceedings,* Vol. II, p. 278.

‡ *Proceedings,* Vol. I, p. 13.

disturbance of the pure premium by not over 5 per cent. is not very serious. And suppose under a certain law, the maximum death benefit is limited to $4,000. Any pure premium volume of $80,000 would seem to offer a dependable basis under the circumstances. With a pure premium of 25 cents, this would require a payroll exposure of $32,000,000. With a pure premium of say $2.00 only $4,000,000. Surely there are numerous classifications which would satisfy such a requirement in many states. The standard may be doubled and even increased tenfold, without making impossible for some states to produce, if not in one year, then in a few years, a dependable experience of its own. This is especially true of certain large industrial states of the east. In New York state alone, for instance, according to the Census of 1910, there were 80 manufacturing industries with an annual payroll exposure of over $1,000,000, 23 of them with a payroll exposure of over $5,000,000, 11 with an exposure of over $10,000,000; and 4 with an exposure of over $40,000,000 a year. By this time, due to the normal growth, the extraordinary industrial activity, and the substantial increase in money wages, the number of dependable exposure is very much larger. Surely the classification of "Clothing, Men's" or "Clothing, Women's" or "Machine Printing," in the state of New York does not need any law differential to determine its true pure premium—provided, of course, that the law, or at least its scale of compensation benefits has not been modified meanwhile. And I believe that in such cases the law differential method should be definitely abandoned, and entire reliance given to individual state experience. It would seem that a state authority entrusted with rate supervision would be justified in creating such a list, and gradually adding to it, so that in case of discrepancy between the local pure premium, and that derived from the basic pure premium, the latter should be definitely discarded.

So far is Mr. Ryan's statement correct. And in many other states other or, perhaps, similar branches of industrial activity are similarly situated. But even if this were true of the greater part of the entire payroll exposure, which I believe is doubtful, even then would the method of law differentials remain useful, nay, altogether necessary, if compensation rate-making is to remain free from guesswork or manipulation. Even taking the country as a whole, in 1914 there were 69 specified industries (which include many classifications) with a payroll less than $1,000,000 out of a

total number of 256 industries specified, and 156 of them had a payroll of less than $5,000,000.* And what would become of the smaller states with a scattered industrial activity? Let us take one or two such states of the United States. In Nebraska, 25 industries are listed for 1909, and only 3 of them had a payroll over $1,000,000, the highest being less than $4,000,000. In North Carolina, out of 44 industries listed, only 2, cotton goods and lumber, rise to $10,000,000 or over, while 38 had less than $1,000,000 payroll, and 24 less than $100,000 a year.† Often a classification with a substantial exposure in one state may have a very small one in another state. The desirability for the latter to draw upon the experience of the former is obvious. Still more frequently the industry is so thoroughly scattered that no one state can expect to accumulate the necessary experience and a combination of the experience on a national scale becomes necessary. A law differential is the necessary instrument for affecting such a combination. I am aware of the fact that an entirely different remedy was ably suggested for this difficulty by Dr. E. H. Downey in his paper on "Classification of Industries for Workmen's Compensation Insurance,"‡ namely, a reduction in the number of classifications, not only by the establishment of the groups, as is being done by the Joint Conference in the preparation of pure premiums, but also by an entirely different system of classification based upon fundamental processes of operation.

This raises the very complex problem of classifications which lies largely outside of the domain of the problem studied in this paper. I have no intention to complicate matters by any excursion into other fields. It is referred to briefly here, only for the reason that the law differential and a simplified classification may be brought into opposition as two alternative methods of dealing with the same problem of insufficient exposure. In fact, this argument is made to some extent by Dr. Downey when he says: "There are somewhat narrow limits of time and space within which exposure are comparable," and again— "Great caution must be used in combining pure premiums experience under different laws. As to the combined pure premium for a long term of years, under different compensation acts, and in widely separated localities, the factors of

* Statistical Abstract for 1916, Table 127.

† Census of 1910, Vol. IX, p. 915.

‡ *Proceedings*, Vol. II, p. 10.

disturbance are so numerous and so potent that the aggregate result must be thoroughly untrustworthy." Under certain conditions these strictures may be fully justified. But they do not offer a sufficient basis (nor does Dr. Downey offer them as such) for rejecting the method of state law differentials IN TOTO. Surely no one would suggest that the experience of any state or any classification be cut up on territorial lines, and experience of different states does not as a rule mean the experience of widely separated localities.

In fact some of the arguments advanced by Dr. Downey substantially strengthen the case in favor of law differentials. For it is undoubtedly true that often limits of time circumscribe the usefulness of experience gained. It follows, therefore, that in so far as experience may rapidly become antiquated, what is lost in this direction must be gained by the widening of the area of observation, which again means the dependence upon law differential. Of course, if the compensation insurance business were willing to establish a new simplified system of classifications with a much reduced number of hazard classes, then the independence of *some* states (and only some) from the experience of any other state might become possible. But so far as known, no such changes are even contemplated. And finally, the differential method preserves its usefulness at the time of introduction of any new law, and within the limits of any one state, every time changes are introduced in the benefit scale.

If the law differential is thus not only justified historically but proven to be a factor of permanent value in compensation rate-making, a criticism of its methodology becomes decidedly worth while, and after over six years' experience with compensation insurance, and three years' utilization of the differential method, the time seems sufficiently ripe for the occasion.

In actual practice both the combination of experiences of many states and the derivation of the rates for separate states from our basic rate has been done on the basis of the Standard Accident Table.

In the report of the Actuarial Subcommittee of the Joint Committee, the following suggestion has recently been made:

"The Committee recognized that the rise of experience differentials would simplify many parts of the work. . . . Such a differential of necessity combines in itself all of the factors by which

we would pass from the basic pure premium to the state pure premium for the latest experience available and the resulting problem would be merely to pass from such latest experience to the probable experience of the period for which the rates are to be made. A majority of the Committee, however, felt that the departure from past practice was too radical and the volume of data and the extent of time at the disposal of the Committee too limited to warrant the abandonment at this time of established methods."

Again, it is necessary to point out that the suggestion as to the use of experience differentials is not entirely new. In 1915 the effort has been made to check up several state differentials by comparing the actual experience. The results were, as far as the writer remembers, not uniformly satisfactory, though on the whole lending support to the prospective method.

The method of experience differentials deserves a good deal more attention and confidence than it has as yet received. If, for instance, the results of the experience were altogether contrary to those derived from the valuation method, public policy as well as good business sense would demand that the latter should be discarded. Employers should not be expected to pay more than the actual cost, and the insurers should not be required to carry the risk at a rate below cost just because an abstract formula produces certain figures. Theory must yield to facts, rather than facts to preconceived theory.

Several difficulties of the experience method must, however, be taken into careful consideration. Complete reliance on the relation between the average pure premium of two states would be grossly misleading, because the difference might be due entirely to unequal distribution of hazardous and non-hazardous industries in the two states. The total loss of one state may be computed on the basis of the exposure of the basic state, the payrolls of the various classifications in basic State A being multiplied by the respective pure premiums in State B, and the theoretic loss thus obtained being compared with the actual loss in State A. Here is a hypothetical and simplified illustration.

What conclusions may be derived from the above facts? The average pure premium in State A by actual experience is 99 cents and in State B is 48 cents. If State A be assumed as the basic state then the differential for State B on the basis of the combined experience appears to be .485. If the pure premiums of B are

applied to the payroll of State A the average pure premium obtained is 168, and the differential appears to be 1.697. If the pure premiums of State A are applied to the payroll B, the average pure premium appears to be $1.34 and the differential for B figures at (48:134) .358. And finally if the combined payrolls are treated by either series of pure premiums, the resulting differential is .935.

Class.	State A.			State B.			Losses if Payroll A. and P. P. as in B.	Losses if Payroll B. and P. P. as in A.	Losses on Combined Payrolls A. and B. if	
	Payroll in (1,000).	Losses.	P. P.	Payroll in (1,000).	Losses.	P. P.			P. P. as in A.	P. P. as in B.
1	5,000	62,500	1.25	200	5,000	2.50	125,000	2,500	65,000	130,000
2	2,000	10,000	.50	300	1,200	.40	8,000	1,500	11,500	9,200
3	1,000	7,500	.75	1,000	9,000	.90	9,000	7,500	15,000	18,000
4	300	300	.10	2,000	1,000	.05	150	2,000	2,300	1,150
5	200	4,000	2.00	5,000	25,000	.50	1,000	100,000	104,000	26,000
	8,500	84,300	.99	8,500	41,200	.48	143,150	113,500	197,300	184,350
							P. P. 168	1.34	1.16	108½

Which of the four differentials is valuable for rate-making purposes, .485, 1.697, .358 or .935? It would not do to argue that the illustration damns the whole method of differentials as untrustworthy, because the differences for individual classifications are so wide. The amount of exposure in almost each case is so small that the pure premiums are unreliable if taken separately, and I believe every member of the Rate Conference will corroborate the statement that actual experience showed even wider fluctuations. To be sure, the entire illustration is purely hypothetical. In actual practice differences in weighting individual items for the purpose of obtaining a weighted average do not so forcibly affect the final result, as is possible to show by means of an arbitrarily chosen illustration. But the writer states on his honor that the figures were selected without bias, just as they happened to come along in order to test the theory.

What guidance for rate-making does one obtain from these figures? Simple inspection seems to indicate that State B has a cheaper law than State A. But how much cheaper is it? An accidental death in the 5th classification in State A and in the 1st classification in State B creates a situation that baffles even efforts to check a differential, let alone obtaining one from the figures at hand. Yet the essential difference in the distribution of the payroll is not greater than may be observed when one compares

mining states with lumbering states, large metal-working states, textile states, and so on and so forth.

It is not my intention to argue that the experience-differential method should be entirely discarded. Possibly the solution may be found in applying the pure premiums of every state to a standard payroll, prepared from data for the entire country, or for certain sections of the country. Even then the danger of undue influence resulting from an accidental heavy loss in a classification of very small exposure might remain. Perhaps this could be corrected by eliminating or consolidating the experience of classifications with a very small exposure. But enough has been said to indicate that the retrospective method is not as simple as it might look at first glance, that it has many pitfalls, unless, indeed, the exposure on individual classifications is large enough to offer a sufficiently broad basis for a fair average, and it has already been admitted that in such cases no differential at all is necessary as far as that particular state and classification is concerned. Whenever this condition is absent, the valuation method still retains its usefulness.

The Standard Accident Table.

At the basis of this valuation method lies the Standard Accident Table. Does it meet all the demands that must be made of it? Is it sufficiently accurate for the purposes to which it is applied? It will probably be admitted that I need not be suspected of any undue prejudice against the Standard Accident Table. As a preliminary study and still as an emergency measure during the strenuous days of 1914, I believe that the Standard Accident Table has amply justified itself.

The essential factor in its construction is the distribution into five groups.

Total	932
Total permanent disability	133
Permanent partial disability	2,442
Dismemberment	2,300
Total temporary disability	94,193
	100,000

There have been several criticisms of these major classifications by more or less prominent statisticians, of which perhaps the most careful was that by Professor Willard Fisher, in the *American Economic Review* for December, 1915. Though on the whole the

review is favorable, Dr. Fisher seems to have questioned the fundamental underlying principle of the Table when he writes:

"Dr. Rubinow's fundamental assumption that the distribution of injuries will be approximately the same in all lands . . . is not consistent with the intrinsic probabilities of the case." It is perhaps unnecessary to argue this point at this place, because that has already been done before,* and because without this fundamental assumption there is no purpose in the compilation of the Table.

The specific criticisms of Dr. Fisher were directed against the assumed number of total and permanent disability and of partial permanent disability cases, and their distribution by degree of disability. Most of the criticisms, oral or written, have been directed largely at these two points. Nevertheless, such evidence as has developed until now seems on the whole to corroborate the table at least in its essential outlines and recognition of this fact is not wanting.

That seems to hold true of New York experience (see Dawson, *Proceedings,* Vol. I, p. 104) except for permanent disability cases, which had not developed because of lack of time, of the Nevada experience, except for a higher proportion of fatal accidents because its experience largely refers to mining industry.†

Thus the New York comparison:

	No. of Cases (Rubinow).	No. of Cases (Actual).
Fatal	16	16
Dismemberment	42	44
Total permanent, not dismemberment	2	1
Partial permanent, not dismemberment	44	0
Temporary total, not compensatable	1,098	1,014
Temporary total, compensatable	598	725
	1,800	1,800

And the Nevada comparison:

	Standard Acc. Table.		Nevada Experience.	
	No.	P. C.	o.	P. C.
Fatal	932	.93	.75	2.34
Dismemberment	2,323	2.32	.65	2.02
Total permanent dismemberment	110	.11	.02	.06
Partial permanent dismemberment	2,442	2.44	.80	2.49
Total temporary	94,193	94.20	29.91	93.09
	10,000	100.00	32.13	100.00

* *American Economic Review,* March, 1916, pp. 250–258.

† Nevada Report of Industrial Commission, 1913–1916, p. 10.

But while the Standard Accident Table has justified its use at least in an emergency, it is by no means so perfect that no revision is required.

Not only should we be in a better position now than we have been three years ago to do that, because we have or should have that much more experience to draw upon, but also because we have had that much more time to study the problem and gather material.

The following criticism may be made at least tentatively against the Standard Accident Table:

It is based almost exclusively upon European data, which were the only ones available at the time. But since its use is primarily intended for comparisons between one state and another on this continent, it would be desirable and would meet a good deal of criticism, if at least gradually data from American experience were carefully gathered. It is at least possible that modern treatment and modern American surgery have substantially affected the table in certain points, as, for instance, in the elimination of some permanent disability cases.

It is true that notwithstanding five or six years of compensation, American accident statistics is still far from ideal, nevertheless, some valuable data are being sporadically published by some of the compensation states—notably California, Wisconsin, New York, Massachusetts, Michigan, Illinois, Maryland, Washington, Nevada and others. Massachusetts data for one year was utilized to some advantage in the construction of the Standard Accident Table. There is no scientific reason why other statistical data which have accumulated since then should not be utilized as well. This is not devoid of many difficulties. Notwithstanding a good deal of discussion the hope of a uniform system of compensation statistics is still one of those hopes deferred which maketh the heart sick. There is no dearth of organizations which seems to work for such uniformity:

1. The Statistical Committee of the National Association of Industrial Accident Boards and Commissions.
2. The Compensation Committee of the National Association of Insurance Commissioners.
3. The Statistical Committee of the National Workmen's Compensation Service Bureau.
4. The Casualty Actuarial and Statistical Society of America, and
5. The United States Bureau of Labor Statistics.

These are all organizations interested in the ideal of uniformity. But a recent effort to combine all available statistics of accidents convinced one that as yet very little has been accomplished. Over a year and a half ago, the Actuarial Committee of the Joint Conference on Workmen's Compensation Rates made the following recommendation to the Conference:

"The Committee feels . . . that the Conference should recommend to the Casualty Actuarial and Statistical Society of America that at its early convenience it take the necessary steps towards the development of a new table based upon an enlarged American experience."

As yet nothing has been accomplished beyond the adoption of this recommendation, at least nothing that the public at large is aware of. It is singular that the little isolated state of Nevada, with its small state fund, should remain almost the only state which published scientific compensation accident statistics in conformance with the uniform standard and readily comparable with the Standard Accident Table.

It is quite likely that because of the heavier character of American industry, a higher proportion of fatals should be assumed. The total number of dismemberments may be fairly accurate, but it at least is possible that its structure will require substantial modifications. The schedule of dismemberments was adopted from the statistics of only one country—Austria. Besides, the material was about fifteen years old. The results of recent plastic surgery must have been considerable. Moreover, some items are too comprehensive and should be further distributed, as, for instance:

Item 15, loss of thumb and one or more fingers, left hand.
16, loss of thumb and one or more fingers, right hand.
17, loss of two or more fingers, left hand.
18, loss of two or more fingers, right hand.
29, loss of fingers, accompanied by injuries of other fingers, left hand.
30, loss of fingers, accompanied by injuries of other fingers, right hand.
33, loss of toes.

There is a noticeable absence of data in regard to loss of foot, and items 1 and 2, loss of one arm, and item 31, loss of one leg, might be further analyzed according to different scales for loss of forearm, below elbow, at elbow, between elbow and shoulder, and at

shoulder, etc. Items 15, 16, 17, 18, 29 and 30 alone represent 495 out of 2,323 dismemberments or over one fifth. Another fifth is represented by case of loss of one eye, and this one item has justly roused many suspicions as to its accuracy.

The number of permanent total and partial disabilities has already been referred to. These groups of cases proved to be the most difficult to handle. The reason is obvious. In the discovery of these conditions and especially in their appraisements, the element of human judgment enters very largely. It is quite likely that for some time the tendency in this country has been and will be to judge these cases too lightly. For this reason the number of cases to be expected was estimated as low as appeared consistent with safety. But all of this is not an excuse for failure to check up this part of the table; on the contrary, it is an argument in favor of urgency of such a check.

Still more important is this distribution according to degree of disability. The Standard Accident Table distributes these 2,442 accidents on the theory that they are compensated in a manner similar to that of most European countries, i. e., by partial weekly benefits, as the exact language of the law seems to require in most states. As a matter of fact, however, this method is hardly used at all in any of the states, outside of possibly Massachusetts and the states which have adopted the Massachusetts act. In fact this difference between the Massachusetts act and most other acts created some very serious difficulties which will be referred to presently. The typical American method of compensating these injuries, provided for in many states by specific language of the law and followed in many others by imitation without any definite legal sanction, is by valuation in proportion to total loss of part.*

Under the circumstances an entirely new rearrangement of the 2,442 cases is necessary as an alternative to that by degree of disability. Three years ago the situation was not quite clear, nor were any data on this subject available, but by this time such information could be obtained either from the official records of some industrial accident commissions or from the private records of insurance companies without any excessive labor or cost. The question to be solved is: What sort of injuries constitute this group of accidents and what is the customary method of their compensation?

* For the discussion of this method see "American Methods of Compensating Permanent Partial Disabilities," by I. M. Rubinow, *Proceedings*, Vol. II, pp. 235–252.

Finally as to the group of temporary total disabilities, from evidence obtainable this appears perhaps less in need of revision than other groups. But, on the other hand, it is the easiest group to construct on the basis of American states, because the classification of temporary injuries according to duration is easily made, and the necessary data are found in most state compensation statistics reports.

The absence from the table of cases of temporary partial disabilities has been frequently commented upon. The reason for it is altogether a technical one, the absence of reliable data at the time. But some information has been accumulated and must be available at present. This, of course, is not so much a separate group of accidents as a supplementary benefit for accidents appearing in the table as temporary total cases, or an alternative treatment for so-called permanent partial cases. In fact in one sense all the 2,442 cases in most states may be designated as temporary partial cases, either because they are compensated in approximation to dismemberments for a specified number of weeks, or because they are subject, as are the temporary total cases, to a maximum time or money limit. But the failure to recognize the temporary character of the cases, or at least of their compensation, introduces serious errors when acts with different time limits for such cases are compared.

In addition to the main table there are certain supplementary tables which must be made use of when the provisions of the law require it. The most important of these deal with the fatal accidents, their distribution according to marital condition, and number of dependents. Three years ago, when there was neither time nor facilities for ascertaining actual conditions, some broad assumptions were made. It is unfortunate that these assumptions are still being used without any serious effort to verify them. The effect of that assumption upon the final valuation of this table is very strong. And dealing with social rather than physical facts, they are subject to much greater fluctuation as between state and state. Data of this character for each compensation state should have been carefuly collected by this time.

Methods of Valuation.

So much for the Standard Accident Table. Still more important are the methods of valuation of the table for the purposes of computing the differential. Unfortunately, no detailed account

of these methods with proper actuarial material has as yet been published beyond a few brief remarks in my article in the first volume of the *Proceedings,* and in my book on the Standard Accident Table. It is manifestly impossible to go into any detailed description of these methods here. But assuming that to most members of this Society these methods are fairly familiar, the weakest spots may be pointed out.

The method of valuation, with proper discount for present values of either annuities certain, or temporary or life annuities subject to effect to mortality and remarriage, permits of a certain degree of accuracy, provided an agreement is reached as to most fundamental assumptions. And yet substantial differences have occasionally developed when differentials have been independently computed by different actuaries. This is a subject which the writer feels constrained to discuss with some delicacy, and therefore the discussion will be carried on in general terms, rather than by reference to specific cases.

The valuation of temporary total disability, and of dismemberments, where a dismemberment schedule exists, is a simple problem, which has not developed any difficulties or controversies. The problem of valuation of death benefits is actuarially more complex, but the possibilities of error arise largely from differences of structure of the Standard Accident Table than the methods of computation. A suggestion might be made that the wholesale computation for the "average widow" is rather crude, especially when the factor of remarriage enters into the compensation, and a refinement of this method by the use of actual age data of a fairly representative number of widows would not seem to offer any unsurmountable difficulties. As to the deep and grave problem of remarriage (deeper and graver than the problem of marriage) perhaps it is best not to raise it at this hour at all, beyond simply referring to it. That the habits, looks and other qualifications of American widows may differ in many respects from those of Dutch widows, all actuaries, it is hoped, recognize, but the situation for many years may not permit of any remedy, since a remarriage table cannot be constructed in a year or two. Perhaps the suggestions may be thrown out, that while a brand new table cannot be constructed in a few years, a comparison between the expected and actual results for the remarriage may be made, as such comparisons are made for expected and actual

mortality, and on the basis of ascertained gain from excessive remarriage, or loss from insufficient remarriage, adjustments on differential tables could be made, especially if some regularity should be discovered in these results from year to year. With some 1,500 fatal accidents in New York state alone sufficient material should become available for such a task in a few years.

There are, however, three important problems in connection with the methods of valuation of the Standard Accident Table and the computation of the differential, that must be more carefully considered.

1. The valuation of permanent partial tables.
2. The computation of medical costs.
3. The valuation of the effect of limits.

Valuation of Permanent Partial Disability Cases.

It has already been indicated that the possible error here may partly be charged to the deficiency of the table itself, in that it fails to differentiate between permanent and temporary partial disabilities. Such failure was due at the time to the difficulty of obtaining reliable data. Besides there is undoubtedly a certain difficulty in proper interpretation of the terms. Most of these cases are of a permanent character as far as the surgical nature of the injury is concerned (though this permanency may not be as absolute as in the case of dismemberment). Occasionally some of these troublesome fractures, dislocations, contractions, etc., may be overcome after a lapse of years, but more frequently the economic damage gradually vanishes, even though the physical results of the injury remain. As a result, even in Germany, the classical country of permanent pensions for partial disability, injuries in many cases seemingly permanent in the early stages gradually continue to recover for years in succession.

The absolute distribution of the accidents among the five groups is not comparable with the Standard Accident Table, because German statistics deal only with accidents of over 13 weeks' duration. The significant feature of the above table, however, is the reduction in the proportion of permanent partial cases from 44.27 per cent. to 37.40 per cent., a reduction of some 15 per cent. As a matter of fact this does not demonstrate the entire strength of the tendency, because the earliest results shown are for accidents occurring in 1904

as at the end of 1905, on an average of 18 months after the occurrence of the accidents.

The following data demonstrate this conclusively:

RESULTS OF 65,205 CASES OCCURRING DURING 1904.*

Result of Accident.	At End of 1905, Per Cent.	At End of 1906, Per Cent.	At End of 1907, Per Cent.	At End of 1908, Per Cent.
Fatal	7.63	7.81	7.96	8.06
Total permanent disability	.93	.80	.78	.81
Partial permanent disability				
Under 25 per cent	25.90	25.38	24.60	24.17
25–50 per cent	12.74	10.97	10.07	9.27
50–75 per cent	3.80	3.48	3.18	3.01
75–100 per cent	1.83	1.29	1.15	.95
	44.27	41.12	39.00	37.40
Temporary partial disability				
Under 25 per cent	19.67	14.14	10.59	8.15
25–50 per cent	3.93	2.14	1.39	.98
50–75 per cent	.50	.23	.16	.12
75–100 per cent	.48	.17	.15	.11
	24.58	16.68	12.29	9.26
Complete recovery	22.59	33.59	39.97	44.37

Equally significant is the evidence that nearly 25 per cent. of these accidents at some time fall into the category of temporary partial disability cases. Moreover, the reduction in the number of cases of high partial disability is greater than in low partial disability cases.

What effect has the disregard of these conditions upon the computation of differentials?

Two methods have been used in arriving at the valuation of the 2,442 permanent partial cases, the choice between the two methods depending more upon the language of the act than the actual methods used in their adjudication. In the case of the differential for a new act, this language is the only thing to go by. But that does not justify the failure to adjust the method to the actual conditions of claim settlement when these conditions can be ascertained.

One method is to calculate the average degree of disability for the 2,442 cases and to compute their valuation in the hypothesis that a partial weekly benefit proportionate to the degree of dis-

* Henry J. Harris, Ph.D., "Industrial Accidents and Loss of Earning Power." German experience in 1897 and 1907. Bulletin 92 of the United States Bureau of Labor Statistics.

ability is paid for the exact maximum duration for which the law provides. As a matter of fact in very few states does this method of compensation actually prevail, and yet this method of compensation has been used in a great many state law differentials.

Now, since the purpose of all differentials work is a relative and not an absolute valuation and since no matter what the actual method of compensation used, there must be some relation between the amount of compensation and the gravity of the injury, the error thus introduced would not appear very serious, so long as both states compared (e. g., the old Massachusetts act and the act of the state for which a differential is desired) had provisions essentially similar. But if, as explained, the error committed is in assuming that in all the 2,442 cases payment will continue up to time limit provided for the law—and if this is a substantial difference in such time limits, the resulting error may be (and in fact in several states was) very grave, as can be readily shown by one or two other illustrations.

Let us for instance compare the New Jersey act and the Connecticut act. Under these two acts the valuation of the 2,442 cases is as follows: (the average degree of partial disability being 22.4 per cent.).

Average weekly benefit (both states) .50 w.w. $\times$ .224 = .112 w.w.
Average annual benefit (both states) .112 w.w. $\times$ 52 = 5.82 w.w.
Duration of benefit (deducting 11 w. for total disability):

New Jersey, 300 w. — 11 w. = 289 w. = $5\frac{29}{52}$ years = 5.5577.
Connecticut, 312 w. — 11 w. = 301 w. = $5\frac{41}{52}$ years = 5.7692.

Present value of temporary annuity, age 37, Am. Exp. Table, $3\frac{1}{2}$ per cent.:

New Jersey, for 5.5577 years — 4.7323,
Connecticut, for 5.7692 years — 4.9329.

Cost per case:

New Jersey, 5.82 w.w. $\times$ 4.7323 = 27.542 w.w.,
Connecticut, 5.82 w.w. $\times$ 4.9329 = 28.709 w.w.

Cost for group of 2,442 cases:

New Jersey, 27.542 w.w. $\times$ 2,442 = 67.258 w.w.,
Connecticut, 28.709 w.w. $\times$ 2,442 = 70.107 w.w.

The difference in this case is so slight that the final differential cannot be seriously affected by any error in the assumption.

But the situation becomes very much different when a longer time limit is provided.

Thus the 8-year time limit in Illinois results in an annuity value of 6.4336; a value per case of 5.82 w.w. $\times$ 6.4336 = 37.444 w.w., and a total value for the group of 37.444 w.w. $\times$ 2,442 = 91.338 w.w., an increase of over 20,000 w.w. or about 5 points in the differential. And yet it is quite certain that the existence of the higher limit does not effect all cases, in fact it is doubtful if it affect any perceptible proportion of them and the increase of the 5 points appears in a nature of penalty for the language rather than any substantial provision of the act.

The situation becomes even more aggravated where no limit, or only a very high money limit, exists. If the language of the act is followed, purely fictitious values are obtained. Compensation actuaries need not be reminded of the serious controversies that resulted from differences of opinion upon this one point when the New York differential was being computed in 1914. In other states, also, e. g., Maryland, Colorado, etc., the method had to be discarded entirely because values obtained were palpably fanciful. For a time the entire method of differentials or at least the Standard Accident Table seemed in danger of being discarded, because the results obtained appeared too much at variance with the probabilities of the case. It is, I believe, admitted now, that the difficulty was one of detail, or at worst of faulty application, rather than of the method itself.

As an emergency measure, in several of the state differentials referred to, an entirely different method of valuation of this group had to be resorted to. Namely, since partial disability cases were compensated by comparison with dismemberments, an arbitrary relationship was assumed between the cost of an average dismemberment, and an average partial disability case. Under this rule the chance of introducing errors is very much smaller, since, as already explained, the valuation of dismemberments is a simple matter, and the difference of valuation of the permanent partial cases in two laws would simply strengthen the difference in the valuation of dismemberment.

The only assumption necessary is the ratio between the cost of the average dismemberment case and the average permanent partial disability case. The percentage of 70 per cent. was hit upon in the case of one or two states for lack of more accurate informa-

tion. It is very unfortunate that until now more reliable information is still not available, and that of all the states Nevada seems to be the only one which published definite figures concerning this issue. Experience for three years in that state indicates the following results:*

	No. of Cases.	Total Compensation Entire Cost.	Average Cost per Case.
Dismemberment	111	$84,760.88	$763.61
Permanent partial disability	125	96,015.10	768.12

The fact that the proportion in the number of cases of the two groups is almost identical with that assumed in the Standard Accident Table (125:113=1.13, and 2,442:2,300=1.06) may add a little additional weight to this exhibit. If the experience of Nevada is characteristic, then the average cost of a permanent partial disability is equal to the average cost of a dismemberment, and since in no case was such an assumption made in the computation of differentials, they are all faulty to that extent. But why should there be any doubt concerning this very important matter? Surely what Nevada has done, Massachusetts, New York or Pennsylvania can do to ascertain the true facts.

Cost of Medical Aid.

Perhaps no other point in the computation of the differentials presented so many difficulties as the case of medical aid. In distinction to the situation in regard to permanent partial disability cases, there are almost no standards in the medical provisions of the acts. The differences are innumerable and bewildering.† The time limits are different, the money limits are different, the degree of administered supervision oevr medical fees in the various states is different and the customary standards of medical fees also differ widely in various localities. Added to all this, and seriously complicating the issue, is the fact that the valuation of the Standard Accident Table is made in terms of weeks' wages, while medical expenses have no relationship to the wages of the insured.

* Report of the Nevada Industrial Commission, 7/1/13–6/30/16, p. 69, Table 21.

† I. M. Rubinow, "Medical Aid under Compensation," *Journal of Political Economy*, June–July, 1917.

Since the entire basis of the differential method is to ascertain the average cost per accident, the question of medical costs reduces itself to the average cost per accident under different acts. While there were some statistical sources (private and public) available in 1914 to the Committee, they were expressed in terms of a proportion of medical costs to all other compensation costs, for several states with substantially different medical provisions.

The method therefore used at the time was as follows. The proportion between medical cost and all other costs was ascertained for Massachusetts from official data as 24.5 per cent., for Illinois from data of casualty companies as 27.7 per cent., etc.

2. The gross valuation of the table for Massachusetts, excluding medical aid, without deduction for discount of future payments, was determined at 361.947, for Illinois at 430.200 w.w. Medical costs therefore were for Massachusetts 361.947×24.5 per cent. $= 88.677$ w.w., for Illinois 495.605 w.w. $\times$ 27.7 w.w. $= 137.283$ w.w.

3. These figures were accepted as typical of the cost of medical aid, under the respective provisions, the Massachusetts figure for 2 weeks, and the Illinois figure for 8 weeks with a $200 limit. A similar method was used for one or two other states, and for all other states the respective figures were obtained by a process akin to interpolation. The provisions for medical aid were compared with those of Massachusetts or Illinois and a figure in w.w. was assumed as representing the cost of medical aid for 100,000 accidents either by loading or discounting the known figures.

In other words, from somewhat crudely ascertained values of average cost of medical aid per accident, expressed in weeks' wages for a few states, similar values were derived for all other states. Thus in Massachusetts the average cost was .89 week's wages, in Illinois 1.37 weeks' wages, but in California 1.50 weeks' wages. In Connecticut the cost was assumed to be 20 per cent. over Massachusetts, or 1.07 w.w., in Michigan as $\frac{1}{3}$ over that in Massachusetts, or 1. w.w. per case; wherever the medical provisions of the new act were identical with those of an older act, the same average cost (in weeks' wages) was also assumed, as for instance in Iowa or Louisiana, equal to Massachusetts; in Indiana as in Connecticut, etc.

Since the problem was to arrive at many unknown quantities from a few known ones, perhaps no apologies need be offered

for the method and its use in 1914. But the opportunities of error were obviously many and grave. In several check computations of the state differentials made within the last year for official bodies, or private clients, I was forced to differ substantially on this amount to be charged for medical aid. There is no intention to thrash these differences out before the Casualty Actuarial and Statistical Society of America, but it may be worth while to point out what these opportunities of error in the method above described are.

1. The very proportion between medical costs and compensation as obtained from accident boards or private casualty companies may be wrong because of errors in estimating unpaid losses. It is known, for instance, that in the beginning of compensation experience almost all states show an alarming proportion of payments absorbed by medical aid, simply because the heavy compensation payments do not mature so rapidly.

2. The application of this proportion, arrived at from experience, to the standard table valuation, will carry with the cost of medical any error that is contained in the table. Thus, if the proper valuation for the table for Massachusetts (old act) were 300,000 w.w., then medical aid would become 73,500 w.w., and if it were 400,000 w.w., then medical aid would become 93,000. It is, of course, very unfortunate that instead of errors of independent judgment as to the separate items counterbalancing each other, one error should create another one.

3. The projection of the probable cost in other states from these data is only a crude guess. The influence of the variable time and money limits is assumed from the known differences of cost in a few states, though these differences may be due to causes other than legal provisions.

4. Finally, in assuming the same cost in weeks' wages for two states because the medical provisions are identical, we disregard the possible difference in average wages, which may give a very much different monetary value.

It is evidently unfortunate that such leeway should exist for independent judgment in what should be a matter for a non-biased computation. The failure to consider the wage differences is perhaps the gravest cause of error. Supposing that the cost of medical care per accident for 2 weeks in Massachusetts has been ascertained at .89 w.w. per case. Supposing we have sufficient influence

to justify the assumption that an extension of the medical aid to 8 weeks would increase the cost by 50 per cent. Does it follow that this cost under a far western act, giving 8 weeks, would be .89 w.w. $\times$ 1.50 = 1.33 w.w.? By no means, for if average wages in the western states are 75 per cent. higher, then an increase in money cost by 50 per cent. might result in a lower value when expressed in weeks' wages $\left(\frac{.89 \times 1.50}{1.75} = .76 \text{ w.w.}\right)$.

Evidently accurate data as to average wages of injured are absolutely necessary for a proper computation of the medical cost, and even if such data were not available when the compensation system is first introduced, there is imperative necessity for an early computation of such data from accident records. Surely there is no justification for failure to revise medical costs on the basis of true wages during the very first year. There is only one accurate basis for computation of medical cost, and that is an average for a fairly large number of cases, and all differentials should receive an early correction on that basis.

Effect of Limits.

The problem involved in the measurement of the effect of limits is a familiar one to compensation actuaries. There is no more interesting chapter in the history of compensation rate-making than Mr. S. Herbert Wolfe's effort to take the limits into consideration. The method suggested by him for use by the Massachusetts Employees Insurance Association (now the Liberty Mutual Insurance Company), and discarded after a brief trial, called forth a very lively discussion at the time. Mr. Wolfe's suggested method in brief consisted in eliminating from the premium charge any excess over that part of the individual wage which corresponds to the weekly maximum benefit; as a corollary it became necessary to assume fictitiously high wage expenditures, whenever the minimum required it. Difficult in Massachusetts, the method would break down altogether wherever several conflicting limits are contained in the law for different injury groups, as, for instance, in New York or in Utah. The decision of the Massachusetts Employees Insurance Association to abandon the method after a very brief trial was additional evidence of the practical difficulties it presented.

In any case the fairly uniform experience of compensation underwriting is in favor of making the premium a charge upon the

total payroll, as the practical objections to its manipulation are very serious indeed.

Instead of this, the actuarial committee proposed a different method, very much simpler, though perhaps lacking the same degree of accuracy.

The method requires fairly reliable data as to the distribution of wages of injured persons. On the basis of such a series, it is possible to compute the actual cost of compensation as well as the hypothetical cost which would have occurred if there had been no limits. The proportion between these two quantities indicates the discount or loading which the limits require. It is unnecessary to go into all these complications at this place.

The possible elements of inaccuracy introduced by any faulty application of this method are mainly two:

1. The absence of data. This is particularly noticeable in case of new compensation acts. The character and quality of wage statistics published by separate states are subject to great fluctuations. It is idle to expect a satisfactory statistical service in many of our political units because of very small population and the heavy burden of state government that it must carry. Sometimes an indifferent assortment of average wage data may exist, but for the problem under discussion such data are absolutely useless. And as already explained, even if wage frequency data are available in such states they refer to all persons employed and not to injured persons. Only after some experience with compensation can the necessary wage statistics be obtained.

As an emergency measure it may be necessary to utilize available statistics of a neighboring state, but such a substitute is seldom reliable, not only because of variations in wage levels, but even more because of variations in industrial activity. Wage in an agricultural state, a mining state, and an industrial state are not comparable, even though they be adjacent to each other.

2. The rapid aging and "spoiling" of the wage data. As yet no printed discussion of this point has appeared, as far as the writer is aware, though the point was brought up by Dr. Downey in a personal discussion. This point has become particularly important at the present time. At best, published wage statistics are several years old. Because of a rapidly increasing price level, and otherwise abnormal industrial conditions, nominal money wages are rising by leaps and bounds. It is doubtful whether com-

pensation acts can or will be amended to meet these conditions. But it is evident, how deeply some maximum limits may cut into the compensation benefits as a result of such wage increases. To quote an extreme example: An $8 limit in Colorado reduces the compensation of a $20-a-week man from the ostensible 50 per cent. to 40 per cent., but if the wages of that same worker rise to $25 or $30, the $8 limit, unchanged, reduces the compensation level to 32 per cent. or to 26.7 per cent., and correspondingly should reduce the cost. Of course statistical data must be retrospective and must be of some age. But this consideration alone makes at least an annual recomputation of all differentials absolutely necessary.

The Selection of a Proper Basis.

For three years the Massachusetts Act of 1912 has continued to serve as the foundation of law differentials, until its use for this purpose has acquired a certain sanctity in the eyes of the insurance business. To the interested outsider, the justification of this tradition does not appear equally obvious. The writer very recently had some difficulty in explaining to the business men of a western state the meaning of the basic pure premium on metal mining, as the cost under the Massachusetts law, because the obvious objection was raised that there could be no such thing, since metal mines were as rare in Massachusetts as snakes in Ireland.

The objections against Massachusetts remaining the basic state are as follows:

1. The act being obsolete, the pure premiums are abstractions which find no test of experience in actual practice of compensation insurance, except in so far as certain recollections gradually growing dimmer may remain within the memory of the underwriter.

2. While most acts, though differing in detail, follow a certain system of compensation, Massachusetts is distinct from other acts; in fact, with Rhode Island and Texas they represent a certain somewhat exceptional type of compensation acts, primarily because of their different treatment of dismemberments, which under the exact language of the law receive both specific dismemberment benefits and compensation for loss of earning capacity, instead of only the former as in most other acts, or only the latter as in the case in a few. The difficulty which was experienced in 1914, and, as far as the writer is aware of, has not been cleared up as yet, is to find out exactly what proportion of dismemberments have actually

received both forms of compensation and what the second payments amounted to. The original assumption was a rather wild guess and until it has been tested not only the Massachusetts but all other differentials must be questioned.

It is true that in so far as the present basis of pure premium is derived not from Massachusetts experience alone but from the combined experience of many states, the effects of any possible error in valuation of the Massachusetts Act are somewhat neutralized. That is, if the valuation of the Massachusetts act has been too low, then the differentials are all too high, but the basic pure premiums are also too low (since in the process of reduction to the basic standard, the losses in each state are divided by the differential for that state) and so the final effect upon premiums may not be very high. Nevertheless there would have been a decided gain in reality if a typical American Act, as for instance New Jersey or Pennsylvania, were taken as a basis.

The specific error introduced by a wrong valuation of the Massachusetts law depends, of course, largely upon the volume of the Massachusetts experience introduced into the computation of the basic pure premium. For this reason the combination of the experience of as many states as possible for the purpose of arriving at a fairly reliable pure premium, and for purposes of eliminating any errors brought in by mistakes in the state differential, is the more important.

Group Differentials Versus a General Differential.

Remains the very important question as to whether a general law differential for a state at large is at all dependable, or whether the theory did not require separate differentials for each classification, or at least for groups of classifications, and if so, what the basis of such groupings should be.

That one general differential was only a rough approximation, or at least an averaging of differences, was recognized by the writer even three years ago.* If is of course but another aspect of the problem already considered in an earlier part of this paper, whether one Standard Accident Table was at all justified for rate-making, useful as it may remain for the purposes of comparing the liberality of the law. Since the Standard Accident Table is but a means of weighing the comparative importance of numerous

* *Proceedings*, Vol. 1, p. 21.

differences which distinguish one law from another, it follows that if accident distribution according to gravity varies from one classification to another, so will the law differential vary. And in addition, other differences must be considered which are not contained in the main body of the Standard Accident Table, as for instance, marital distribution of the wageworker, the proportion of non-resident alien dependents (when subject to special legal provisions) and above all, the wage differences. The theoretical case for the necessity of a series of differentials rather than one, being thus obvious, the first practical question is: how wide is the probable inaccuracy introduced by a general law differential. Is it so serious that it would militate against the propriety of using of general differential at all?

This question will perhaps be best answered by a series of practical illustrations, for which purpose an act with a rather high differential has been selected. Obviously the greater this differential, the greater the possible variations that may result from group differences in accident distribution. The valuation of these two acts, according to the earlier data, the only ones available to the writer, but close enough to illustrate the point, is as follows:

Nature of Accident.	Number.	Mass. Value.	Average per Case.	Per Cent. of Total.	State Value.	Average per Case.	Per Cent.	Ratio Between Two Acts.
Fatal.....	932	97,877	105.03	23.6	138,860	149.00	19.9	1.42
T. P. D.....	113	23,796	210.58	5.7	72,635	642.81	10.4	3.05
P. P. D.....	2,442	34,637	30.56	18.0	136,284	55.81	19.6	1.83
Dismember	2,300	82,209	35.74	19.8	122,153	53.11	17.5	1.49
T. T. D.....	94,193	42,923	.51	11.5	80,518	.94	12.9	1.84
Medical aid	(100,000)	88,677	.89	21.4	137,283	1.37	19.7	1.54
Total.....	100,000	415,124	4.15	100.0	696,733	6.97	100.0	1.68

The second act remains unnamed intentionally, because the question of the accuracy of its valuation is not involved. Furthermore, for the sake of the argument made at this place, the general accuracy of the Standard Table, and of the methods of its valuation are here assumed.

An examination of this table demonstrates that while the general differential is 1.68, for various groups of injuries the differential fluctuates between 1.42 (for fatal accidents) and 3.05 for total permanent disability, the state providing life indemnities for such injuries. The final differential is a result of the weighting of

the specific differentials by the respective weight of the cost of accidents of various groups, as the following computation indicates.

	1. Accident Group Differential.	2. Weight.	One × Two.
Fatal accidents	1.42	23.6	33.5
Permanent total	3.05	5.7	17.4
Permanent partial	1.83	18.0	32.9
Dismemberment	1.49	19.8	29.5
Temporary total	1.84	11.5	21.2
Medical aid	1.54	21.4	33.0
		100.0	167.5

In the case of this particular state, the differential would rise if cases of total permanent disability were more frequent, it would decrease if the fatal cases were more frequent, as compared with the Standard Accident Table, etc. In case of another state, the relationship might be very much different, of course. The question remains how much a slight variation in the table would affect the differential, or, otherwise expressed, how big must the deviation from the standard table be, to influence the differential substantially. For it is true of statistics, as of law, that it does not concern itself with trifles. Undoubtedly, very complicated mathematical formulae might be worked in answer to this question. It is sufficient, however, here to use a few simple illustrations.

In a simplified form the Standard Accident Table might be stated thus:

Fatal cases	9
T.P.D. cases	1
P.P.D. cases	24
Dismemb. cases	23
T.T.D. cases	941

In the following table the differential has been computed for a few assumed modifications of the Standard Accident Table.

	Fatal.	T. P. D.	P. P. D.	Dism.	T. T. D.	Differential.
1	3	1	24	23	947	1.72
2	9	1	24	23	941	1.68
3	18	1	24	23	932	1.63
4	9	–	24	23	942	1.61
5	9	2	24	23	940	1.75
6	9	3	24	23	939	1.80
7	9	1	12	23	955	1.66
8	9	1	36	23	931	1.70
9	9	1	24	11	955	1.66
10	9	1	24	35	931	1.70

The variation of differentials due to deviation from the Standard Accident Table is, therefore, a real factor, albeit not an important one, as may appear at first glance. The question remains, how extensive are the deviations in the distribution of accident gravity, as between one classification and another. It has, I believe, been suggested that separate differentials be computed according to the amount of pure premium, serious and fatal accidents predominating in industries of high hazard and therefore of high pure premium. Too much dependence must not, however, be placed upon this hypothesis, for distribution of accidents by gravity is a statistical concept, separate and distinct from accident frequency or hazard.

It is unfortunate that as yet no satisfactory and ample figures on this subject have been published in this country. With the growing tendency of Schedule Z to call for the number of accidents, as well as the cost, such data might be compiled, and thus an opportunity obtained to test the theory, whether there is any definite relation between the pure premium and the distribution of accidents by gravity. But in absence of such American data, some use may be made of European statistics for purposes of illustration only. In the following table the data are given for French experience, covering years 1901–1908 and over 27 million years of exposure. The general accident rate was 65 per thousand employees per annum, and fatal accidents constituted 4 per *1,000 accidents,* and all permanent injuries 17 per *1,000 accidents.*

The 17 industrial groups are arranged in order of declining accident frequency—with the following results:

Industry.	Accident Frequency (per M. Employees).	Fatalities (per M. Accidents).	Perm. Disabilities (per M. Accidents).	Fatalities and Permanent Disabilities Total per 1,000 Accidents.
Metallurgy	241	2	9	11
Building and construction	121	10	16	26
Chemicals	121	4	9	13
Metals, base, working	119	2	15	17
Earthenware	68	4	13	17
Woodworking	65	4	34	38
Paper	64	4	24	28
Stone cutting	56	5	23	28
Food articles	53	5	14	19
Commerce, etc	45	5	13	18
Hide and leather	30	3	18	21
Printing and publishing	29	1	23	24
Textiles	28	2	27	29
Metals, precious, working	20	4	18	22
Lapidary	20	3	13	16
Straw, feather and hair	15	3	18	21
Clothing	6	2	14	16

If the proportion of fatal accidents varies between 1 and 10 per thousand accidents, and the proportion of permanent disability cases between 9 and 34 (and a finer analysis by subdivisions of these 17 larger industrial groups would undoubtedly bring forth even wider fluctuations), it becomes evident that one general Standard Accident Table does not succeed in creating thoroughgoing justice in compensation rates.

Problems of Organization.

If the point made earlier hold true, that some method of calculating state law differentials is essential, and that valuation of accident series is the best method to compute such law differentials, then it necessarily follows that a system of graded differentials is the next step to be undertaken. It does not represent any unsurmountable difficulties. But it does require careful actuarial work, based upon detailed and accurate statistical information.

Of course such work can not be done without some cost. But can there be any question as to justification of expenses? The errors due to the failure to improve methods of computing law differentials may result in some premiums being 10 or even 20 per cent. out of the way. The business of compensation insurance is rapidly approaching the $100,000,000 level. There is many an undertaking in which such errors represent a loss of a larger amount than the entire organization of scientific differential work would call for.

That the method of law differentials in 1917 is in about the same stage of development as in 1914 is neither to the credit of the casualty actuarial profession or the casualty insurance business. In the February, 1917, report of the Actuarial Subcommittee repeated references are made to the obscure points in differential theory which have to be investigated, only to be dismissed with the statement that "the departure from past practices is too radical and the volume of data and the extent of time at the disposal of the committee too limited to warrant the abandonment of established methods."*

The organization of a standing committee is recommended, but a similar recommendation was made about eighteen months ago without any perceptible results. The Statistical Committee of

* Report of Actuarial Subcommittee, February, 1917.

the National Association of Industrial Accident Commissions has developed statistical standards, but they are scarcely being used. The Casualty Actuarial and Statistical Society had a committee at work for two years, but even the most obvious shortcomings of the Standard Accident Table have not yet been corrected. The reasons are probably obvious ones: The casualty company statistician is pressed by everyday business problems of his corporation, the Bureau officials are engrossed in the numerous demands of intercompany relations, the governmental actuaries and statisticians with detail problems of efficient administration.

Only a special organization, properly equipped scientifically, and free of other duties, can render this necessary service.

For one not directly connected at the present time with any one insurance institution any dogmatic attitude on the proper organization and affiliation of such a service may be an unwarranted presumption. There are, however, a few general observations that may be safely made at this time.

1. If the differential method is to be retained at all, the scientific problems connected therewith become public problems rather than problems of private business. That compensation rate-making is a public function has been the accepted point of view for some time in some states, and the list of states requiring a public control of compensation rates is rapidly growing: Massachusetts, New York, Pennsylvania, California, Colorado, Oklahoma, Texas, New Jersey, Wisconsin, Utah, are only a partial list. Perhaps two thirds of the compensation insurance is already under governmental control as to rates.

2. Though the right of each state to control the rates within its own jurisdiction cannot be denied, it is nevertheless obvious that no state can stand on its own legs exclusively. That the pure premiums are obtained from a nationwide experience, has been recognized. But the mistaken thought frequently prevails that when the method of law differentials is reached, each state is concerned only in its own differential. There is, to my knowledge, no central governmental authority for the control of the differentials as a whole. But a little reflection will show that every state, which presumes to exercise an intelligent, and not a purely formal control over rates, is interested in accurate differentials for all other states without any exception, because every mistake in the law differential must have its effect upon the basic pure premium compiled

from experience scattered all over the country, and converted to the basic law, which is the old Massachusetts Act.

As the work of readjusting basic pure premium proceeds, more and more reliance must be placed upon the purely arithmetic results of the experience, and less and less upon underwriting judgment expressing itself in so-called "selected pure premiums." Such application of underwriting judgment, somewhat akin to the action of "woman's intuition" we hear so much about ("I don't know why I think so, but I am sure I am right"), might remain a valuable adjunct to premium-making, if the basic law were a living system which creates many valuable subconscious impressions—but it must fail when the basic pure premium under an obsolete act becomes a bodyless abstraction.

If therefore the experience of the entire country is to be utilized, if the basic pure premiums are to be saved from gross errors, then all law differentials must be subjected to strict public control, not of one insurance department, not of one state Bureau, but of some national organization in which all compensation states and all insurance carriers are represented. To be sure, no matter what particular form of organization be developed, the same students who have been developing the theory and practice of compensation rates heretofore will continue to do so in the future; but the auspices must not be circumscribed by any geographical or business limitations.

To sum up, the following conclusions may be formulated on the basis of the lengthy discussion here presented.

1. The basis of compensation rates must be found in actual experience—the purpose is to determine what compensation actually does cost, not what it should cost in accordance with any theoretical formula.

2. Barring certain factors which result in time changes, the best basis of determining what compensation will cost in the future is found in the experience of the past.

3. For certain important classifications, the experience within one state is so wide that a fairly accurate average cost may be ascertained for that state and classification alone, and as far as such classification is concerned, the differential method is unnecessary and should not be introduced for mere purposes of uniformity.

4. For most classifications, however, the combination of experience

for the entire country is absolutely imperative, and in such cases a system of differentials is indispensable, both for the purpose of reducing the experience to a common basis and to derive rates for each state from the common basis.

5. A state law differential is absolutely necessary in order to construct at least approximately accurate rates when a compensation law is introduced in a new state.

6. The underlying principle of law differentials must be applied to in order to adjust rates to any modification of the benefit schedule.

7. Between the two methods suggested for computation of state law differentials, the experience method and the valuation of a Standard Accident Table method, the latter method should be preferred, because it is also applicable to new acts and new amendments, and because it has the advantage of comparative simplicity.

8. While the Standard Accident Table has produced differentials, which on the whole were roughly accurate, and perhaps more so than could be obtained by means of any information at hand at the time, a more careful revision of the Standard Accident Table is nevertheless the need of the hour. This applies particularly to details of dismemberments, to the degree of disability of permanent partial cases and the number of dependents in fatal cases.

9. The difficulties experienced at present relate more to the method of valuation of the Standard Accident Table than to the table itself. The most important points on which improvement is necessary are—the valuation of permanent partial disability cases in conformance with the practice obtaining in the various states, a more careful computation of the effects of limits by means of a current enquiry into wage conditions, and a better method of valuation of the cost of medical aid.

10. The time is ripe for substituting group differentials for one level differential. These group differentials should be based upon a classification of industries according to frequency of fatal accidents and permanent disabilities, thus requiring the construction of a series of accident distribution tables.

11. As a basic law, a more typical act than the obsolete Massachusetts should be selected—either New York or Pennsylvania with the introduction of group differentials the necessity for one basic state law would vanish. The state having the largest experience in any classification should be the basic state for the classification and its differential.

12. All these results cannot be accomplished unless the whole subject of differentials is made a subject of continuous careful study. Such study, and the cost of it, are amply justified since law differentials are the most important factor in determining final rates, which must be made by actuaries instead of underwriters.

13. The basic scientific investigation cannot be left to officers of insurance companies, nor to supervising officers, all of whom are under constant pressure of current duties. There is urgent need of a separate organization under whatever name, to pursue these statistical and actuarial enquiries.

14. The point of view is rapidly gaining ground that the computation of compensation insurance rates is a public business, and must be subject to public control. The preparation of the differentials would therefore be best conducted under the combined auspices of all insurance departments, industrial commissions and state rating bureaus.

PREMIUMS AND RESERVES OF THE SWISS ACCIDENT INSURANCE INSTITUTION.

BY

JOSEPH H. WOODWARD.

Recent publications of the Swiss Accident Insurance Institution of Lucerne* furnish an exceptionally rich material for studying the technical methods followed in the administration of the compulsory industrial accident insurance law of Switzerland. The United States is indebted to European countries in a peculiar degree for the various systems of work accident insurance which have been established in the several states, and considerable has been written in this country concerning the European systems of social insurance. Some European statistics have also been available on this side of the Atlantic, but their use has been very limited—partly by reason of the lack of a more precise knowledge of European practices in the computation of premiums and reserves. The publications of the Swiss government, above referred to, are notable in that they supply a clear and unambiguous exposition of those technical methods which are of most immediate interest to underwriters and actuaries. The present Swiss law may be taken to represent the latest and possibly most enlightened European thought upon the subject of compensation for industrial accidents and together with the technical methods developed or followed by the Swiss actuaries constitutes a system which may fairly be considered to reflect the accumulated wisdom of thirty years' experience in furnishing work-accident indemnity. As such it deserves the closest attention of American students.

Before proceeding to a description of the Swiss actuarial methods, it seems desirable to briefly outline the essential provisions of the Swiss accident insurance law and the status of work accident in-

* Schweizerische Unfallversicherungsanstalt in Luzern:

Erläuterungen zu den ersten Prämiensätzen der obligatorischen Betriebsunfallversicherung.

Prämientarif für die obligatorische Versicherung der Betriebsunfälle, 1916.

Die Elemente zur Berechnung der Renten-Deckungskapitalien.

surance in the Federation. The present law was enacted June 13, 1911, and accepted by referendum February 4, 1912.* Previous to the becoming effective of this law, industrial accidents in Switzerland had been compensated under what was known as the Law of Civil Responsibility, under which the employer in most industries was liable to his employee for the cost of medical and surgical attendance, for full loss of the wages from the date of injury in cases of temporary disability, for indemnities based on loss of earning power but with a maximum of six thousand francs in cases of permanent disability, and for specified indemnities to dependents in case of death. Insurance under the Law of Civil Responsibility was voluntary and was carried in stock companies, mutual companies, and mutual trade associations.

The law of 1911 provides for compulsory insurance in a national fund, and is hence known as the Insurance Law. It compensates occupational accidents and occupational diseases due to the action of injurious substances used in the establishment. Manufacturing, mining, contracting and transportation industries are covered.

The benefits provided in the law are

1. Death.
   - *a.* Funeral benefit, 40 francs.
   - *b.* To the widow or dependent widower 30 per cent. of the wages until death or remarriage, with three years' compensation in a lump sum at remarriage of the widow.
   - *c.* To each child 15 per cent. of the wages until age sixteen, or 25 per cent. if orphaned of both parents.
   - *d.* Parents and grandparents and brothers and sisters under age sixteen are entitled to a total annuity of 20 per cent., distributed pro rata.

   Limitation. The total death benefit is subject to the limitation that compensation shall not exceed 60 per cent. of the wages.
2. Disability.
   - *a.* Medical attendance, medicine, surgical apparatus, and necessary traveling expenses.
   - *b.* For temporary total disability 80 per cent. of the wages during disability, commencing with the third day after the

* For an analysis of the principal features of this law see Bulletin No. 203, U. S. Bureau of Labor Statistics, "Workmen's Compensation Laws of the United States and Foreign Countries."

accident. The maximum daily wage considered is 14 francs.

c. For permanent disability 70 per cent. of the wages where the disability is total, with a proportionate percentage where disability is partial. The maximum annual earnings considered are 4000 francs.

Revision of Compensation.—Awards of compensation are subject to revision at any time within three years from the date of accident, provided the degree of disability undergoes any essential change. Later revision may be had only at the expiration of the sixth and ninth years.

Basis of Premium Rates.

The first problem to be considered by the Accident Insurance Institution was how the value of the benefits provided by the Insurance Law would compare with the value of the benefits provided by the Law of Civil Responsibility. Under the regime of civil responsibility the measure of damages corresponded to the entire wages paid from the first day. Under the Insurance Law only 80 per cent. of the wages is granted, and this from the third day after the accident. At this point it was evident that the new law would be much less costly than the old. On the other hand, the abolition of the maximum of indemnity and the consequent replacement of lump sum payments by annuities could not fail to materially increase the cost of insurance in respect of permanent disabilities. For the purposes of rate-making the Institution had at its disposal the statistical experience and rate manuals of European countries in which various forms of social insurance had existed for several decades. In addition, comprehensive statistical data for certain branches of industry were obtainable from the various Swiss trade associations and insurance offices.

Of great interest to those who have followed the recent controversies in this country as to the validity of using a constant differential for all industries in passing from one scale of benefits to another is the following discussion of this question by the Swiss actuaries:

"One might at first glance think that the premium rates of the National Institution might be established by investigating, in respect of the totality of enterprises subject to the Insurance Law,

the relationship between the aggregate cost of such benefits under the Insurance Law and the aggregate cost under the Law of Civil Responsibility. To find the charges under the new law it would then be only necessary to calculate them for each classification by modifying the existing rates by the quotient thus determined. *Such a mode of procedure would lead to the grossest errors,** for the benefits provided by the Insurance Law would not influence in the same degree the rates for the different insured industries, but would have a different effect for each kind of industry. Hence it is not possible to determine the premiums by applying a single coefficient to the premiums under the Law of Civil Responsibility."

After showing that the rates for compulsory accident insurance in other countries could not be directly used in Switzerland by reason of the difference in the benefits, the report discusses the transformation of the existing Swiss material and available foreign material so as to make it applicable to the new conditions. The similarity of this problem to many which are of vital importance in the technical development of workmen's compensation insurance in the United States is striking.

The first step was to divide the premium unit into four component parts, which are treated separately in determining the differential or "coefficient of transformation" to be used in passing from the rates under the Law of Civil Responsibility to the rates under the Insurance Law. These four components, with the percentage of the aggregate cost under the Law of Civil Responsibility which they severally represent, are as follows:

	Per Cent.
1. Medical	20
2. Temporary disability	45
3. Permanent disability	25
4. Death	10
Total	100

Medical.

Under the head of medical, the report discusses, with examples, the variation in the percentages of total cost among various industries. It was considered that as respects medical and temporary disability the existing Swiss data were sufficient to give satisfactory results without resort to statistics of other countries. It is pointed out that where serious accidents predominate, medical constitutes a proportionately small part of the total cost and vice

* Italics not in original.

versa; for example, in woodworking industries it fell to 16 per cent. while in glass works it amounted to 33 per cent. The general conclusion reached was that the cost of medical under the new law might be taken as exactly equivalent to the cost under the old law.

Temporary Disability.

As respects temporary disability, wide variations were shown between the proportionate cost in different industries. In electrical power plants, under the old law, it comprised 39 per cent. of the total cost, while in glass works it amounted to 65 per cent. of the total cost. A discussion of the reduction in the proportionate cost of temporary disability to be expected under the Insurance Law led to the conclusion that the introduction of a waiting period of three days would result in an average reduction of 21 per cent. in the cost of the temporary benefit. Further, the reduction from 100 per cent. to 80 per cent. in the indemnity would, it was estimated, involve a further diminution of 16 per cent. in the cost of temporary disability. Finally, the elimination of indemnity for the first three days and the reduction of the benefit to 80 per cent. of the wages would have the effect of diminishing not merely the number of accidents to be compensated but also the average duration of disability except in those industries where the workers receive through private insurance or in some other manner indemnities supplementary to those which the Insurance Law provides. Taking all of these factors into account, it was felt that under the new law indemnity for temporary disability would not exceed 60 per cent. of the cost under the old law. Consequently, in respect of temporary disability a differential or coefficient of transformation of 0.6 was established.

Permanent Disability.

As to invalidity or permanent disability (including dismemberment) a wide experience as a basis of calculation was recognized as necessary and the material furnished by observations in Switzerland was supplemented by foreign data. Austrian and Norwegian statistics relating to accidents of a greater duration than four weeks were referred to, and the tariffs of the German trade associations, which indemnify for accidents whose duration exceeds 13 weeks, were also utilized. As respects the cost of permanent in-

juries or invalidity, it was pointed out that in those branches of industry where relatively few machine tools are employed the cost is below the average. For example, under the old law, in watch manufacturing it was 16 per cent.; quarries, 17 per cent.; construction work, 19 per cent.; while it rose to 32 per cent. in machine shops and to 44 per cent. in woodworking establishments using machinery. Under the new law these charges were to be notably augmented. It was observed that the cost of such benefits appeared to average not less than five times as high in those countries where indemnity was paid in the form of an annuity as where (as under the previous Swiss law) a lump sum benefit was provided and a maximum of indemnity imposed. It appeared that the maximum indemnity of 6,000 francs provided by the Law of Civil Responsibility rendered useless in most cases any exact determination of the loss of earning power, since the legal maximum was often reached when the impairment of earning power amounted to only 12 per cent. Above this limit the determination of the degree of impairment had no practical interest, and consequently, under previously existing conditions, the more serious dismemberments and permanent injuries were not accompanied by any precise determination of the loss of earning capacity. On the other hand, there were certain factors tending to reduce the cost of permanent disability under the Insurance Law as follows:

1. The fixing of the compensation at 70 per cent. of the wage loss.

2. The effect of the legal provision for a periodical revision of the compensation.

3. The elimination of that indemnity which, as a matter of fact, had previously been paid in cases not really involving any decrease in earning capacity.

The final conclusion reached was that for permanent disability the Insurance Institution would be compelled to pay an amount equivalent to 2.5 times the cost of the benefit under the regime of civil responsibility. Hence the coefficient of transformation in the case of permanent disability was fixed at 2.5.

Death.

With respect to fatal cases it is pointed out that this component of the benefit presents the greatest differences of any as between

one branch of industry and another.* While for some branches of industry it was almost negligible, it amounted to 18 per cent. of the total cost in quarries and to 26 per cent. in electrical power plants. A study of the average present value of the death benefit payable led to the conclusion that under the Insurance Law it would on the average amount to three and one half times the annual wages.† Comparing the cost of death benefits with that under the Law of Civil Responsibility, it was found that this component of the premiums would be about doubled under the new law. Hence, for the death benefit a coefficient of transformation of 2.0 was adopted.

A summary of the subdivision of the relative cost of the two laws is as follows:

	Coefficient of Transformation.	Law of Civil Responsibility.	Insurance Law.
1. Medical	1.0	20	20
2. Temporary disability	0.6	45	27
3. Permanent disability	2.5	25	62.5
4. Death	2.0	10	20
		100	129.5

The average differential or coefficient of transformation to be used in passing from the old law to the new law was thus ascertained to be 1.295.

A table was then prepared showing for each classification in the rate manual the proportionate cost of each of the four component elements of the benefit under both the Law of Civil Responsibility and the Insurance Law. In this way the relation of the total cost for each separate classification was ascertained, so that the rates under the new law were computed by using a separate coefficient of transformation for each classification in the manual.‡

* The prime importance of this fact appears to have only recently received adequate recognition in the United States.

† In New York State the death benefit amounts to nearly four and one half times the annual wages, the difference being in part accounted for by the higher maximum compensation payable, the higher age up to which compensation to children is payable, and the lower rates of mortality and interest assumed in computing present values.

‡ This method of computing pure premiums is in marked contrast to the cruder methods up to the present employed in the United States. See, however, the suggestion by Mr. H. E. Ryan on pp. 188–189 of Vol. III of the *Proceedings*.

Expense Loading.

Having thus determined a scale of pure premiums to be charged under the new law, the actuaries of the Insurance Institution proceeded to a consideration of the loading necessary to provide for expenses. It was considered that expenses were fairly divisible into two parts, (1) those proportional to the cost of accidents, and (2) those proportional to the insured payroll. It was decided that for the first calculation of premiums the administration expenses should be equally divided, one half in proportion to the cost of the benefits and one half in proportion to the payroll. From a consideration of the experience of the private companies it was estimated that the administration expenses would amount to 16 per cent. of the pure premiums. Under the law, the government contributes one half of these expenses, and there thus remained 8 per cent. to be provided for in the premiums. To this was added 4 per cent. to provide a factor of safety. Hence the loading to be imposed upon the pure premiums was 12 per cent. Of this, one half or 6 per cent. was to be assessed in proportion of the payroll, and for this purpose the average pure premium was required to be known. It was estimated that the average pure premium would be 3.5 per cent. of the payroll. Six per cent. of the premium expressed as a percentage of the payroll was, therefore, $.06 \times 3.5$ or 0.21 per cent., which was taken as 0.2 per cent. Hence, denoting by e the pure premium per thousand francs wages the formula for the gross premium became

$$p = e + 0.06e + 2^*$$

In the final determination of the rates the results of the foregoing calculations were examined as to their consistency between various classifications of industry, and for classifications where the exposure was small, rates were interpolated with the help of the Austrian, Norwegian and Dutch tariffs.

* Expressed in notation more usual in the United States and in terms of $100 wages instead of 1,000 francs the formula is

$$P = p(1 + 0.06) + .20,$$

that is to say, the gross premium equals the pure premium loaded by 6 per cent. of itself plus 20 cents per $100 payroll. According to American notions, the proportionate part of the loading assessed as a percentage of the payroll is very high.

Rating of Risks.

The rate manual or tariff of premiums, as it is called, issued by the Swiss Insurance Institution in 1916 is a document of extraordinary interest and doubtless reflects the most recent European methods of classifying and rating workmen's compensation risks. The manual is divided into three parts. First comes a statement of the general principles to be followed in assigning enterprises to the proper classification and also to the proper degree of risk within a classification (the latter process being the correlative of the schedule and experience rating of risks practised in the United States). The second part consists of the manual proper, the industries subject to the operation of the law being arranged in upwards of fifty industry groups, comprising in all about 350 classifications. It is noteworthy that rates are quoted in such a way that the relative hazards of the various classifications within each group are evident at a glance.* Seven different rates are provided for each classification, each rate representing what is described as a "degree of risk" within the classification. A risk, after being classified, is assigned to one of these degrees of risk by following principles somewhat analogous to those upon which schedule and experience rating in the United States is based. A curious but natural feature of the tariff is the relative multiplication and diversity of classifications in those industries for which Switzerland is noted —for example, the watch-making and jewelry industries and the manufacture of laces, embroideries and the finer textiles.

The third part of the manual consists of a very complete and carefully compiled index, which permits instant reference to any desired classification.

Division of Payroll.

The perplexing questions surrounding the determination of proper principles for the division of payroll are not peculiar to the United States, and elaborate rules covering this subject are provided in the manual, although differing somewhat from those with which we are in this country familiar. For the purpose of assigning risks to their proper classification, enterprises are divided into two classes: (*a*) simple enterprises, and (*b*) complex enterprises.

* This contrasts with the American method where the classifications are arranged alphabetically and the natural relationships between them are consequently lost sight of.

Simple enterprises are considered to be those comprising but a single branch of industry or cases where several branches of industry are so organically related that they constitute a single industry. Where accessory branches of an enterprise are lacking or do not have a normal development, this is taken account of in assigning the risk to a particular degree of risk within the classification.

Complex enterprises are considered to be those made up of component parts which are not necessarily or generally found in combination—for example, saw mills and carpenter shops. Such enterprises are rated on the basis of a division of payroll for the separate branches, except that where the locations are the same, the employees interchangeable, or the payroll not separable, the enterprise is treated as a simple enterprise and rated under the governing classification. Branches of an enterprise which are not incidental to the principal business may be separately classified, however many workmen are employed; on the other hand, those which are incidental may be separated only when they employ more than ten workmen. Box and crate manufacturing and container manufacturing generally is considered as not incidental to the general enterprise and hence to be rated separately. Auxiliary personnel, such as those connected with the power plant, with industrial management, with carting, repairing, warehousing, shipping, etc.—all, in fact, which are not exclusively attached to any one branch—are rated under the classification producing the largest proportion of the premium, which is considered to be the governing classification. Small and large enterprises are distinguished at many points throughout the manual, a small enterprise being one employing ten or fewer workmen. For purposes of determining the number of employees, the number of working years in the enterprise is computed by dividing the number of days of actual work during one year by 300.

Degrees of Risk.

A feature of predominant interest in the rate tariff is the plan for taking account of varying degrees of risk within a classification. In the explanation of the rates it is pointed out that this factor is many times of vastly more importance in reaching an equitable rating than is the determination of the classification itself. It is the apparent intent to adjust the premium for the individual risk

in substantially the manner in which premiums in the United States are adjusted through the application of schedule and experience rating. The explanation of the practices of the Institution in administering this feature of the rating is, unfortunately, limited and inadequate. We are given a general outline of the factors which it is intended to take into account through the assignment of enterprises to various degrees of risk, but that detailed explanation of exactly how these factors are utilized, which would be of such intense interest to us, is lacking. In general, the first consideration in determining the degree of risk is the previous accident experience for the enterprise. Where sufficient statistics as to indemnities paid under the Law of Civil Responsibility existed it was possible to take account of the indication of such statistics. It is emphasized that for large enterprises first importance should be given to the statistical history. Other factors considered in the fixing of the degree of risk are as follows:

(*a*) machinery, apparatus and tools employed;
(*b*) general measures for the prevention of accidents and general organization of the enterprise, for example, the use of machines separately started by electric motors, the character of the work place, a free space about the machines, order and neatness, lighting, ventilation, buildings;
(*c*) factory and working rules, prohibition of the use of alcohol, discipline;
(*d*) special measures for the prevention of accidents—for example, safety guards for polishing wheels, safety clothing, rules regarding scaffolding;
(*e*) operation of machines by specially qualified workmen;
(*f*) employment of machines during the full working day or only during a part thereof;
(*g*) piece work;
(*h*) the operation of the enterprise during the entire year or only seasonally;
(*i*) the nationality of the employees;
(*k*) the proportions between the payroll in different branches of the enterprise presenting different hazards;
(*l*) the proportionate number of apprentices and young workmen in relation to the total number of workers;
(*m*) proportionate number of female workers as related to the total workers;

(*n*) proportionate amount of the wages of office employees as related to the total wages;
(*o*) medical service and first aid;
(*p*) supplementary insurance—for example, of the part of the wages not insured by the Insurance Institution;
(*q*) statistical results of accident insurance or of civil liability insurance before the going into effect of compulsory insurance.

Provision is made for the ultimate use of ten differing degrees of risk within a given classification. At present, however, only seven of these are incorporated in the tariff, to which are assigned the Roman numerals I, III, IV, V, VI, VII, X. The degree of risk V is applicable to an enterprise normally composed and representing the average or standard risk.

An examination of the rates shows a striking divergence for the various degrees of risk within a classification. The highest-rated degree of risk oftentimes carries a rate three times as great as that of the lowest-rated degree of risk. It would appear that a free application of this system must produce a general diversity of rates within a given classification far more considerable than the diversities produced by the application of schedule and experience rating in this country.

Comparison of Rates.

In order to permit a rough comparison for a few of the more important classifications between the Swiss tariff and the present premium rates* in force in New York State the following table has been compiled, showing in column (1) the wording of the New York manual classification, in column (2) the nearest corresponding Swiss classification, in column (3) the New York pure premium, in column (4) the Swiss pure premium, and in column (5) the ratio per cent. of column (4) to column (3). Industrial conditions being assumed to be the same in both countries, and pure premiums being assumed to reflect the true hazard in each case, it is evident that column (5) should show the differential between the New York and Swiss laws for the classification in question. It should be borne in mind in this connection that the actuarial value of the benefits of the Swiss law is probably at least 40 per cent. greater than the actuarial value of the benefits of the New York law. The figures in column (3) are taken as 61 per cent. of the

* Effective March 31, 1917.

COMPARISON OF RATES.

(1). New York Classification.	(2). Swiss Classification.	(3). New York Pure Premium.	(4). Swiss Pure Premium.	(5). Percentage of (4) to (3)
1. Cement mfg. — no quarrying	Mfg. of cement, lime, gypsum and mortar, *without* extraction of raw materials	3.36	4.15	124
2. Cement mfg. — including quarrying	Mfg. of cement, lime, gypsum and mortar, *with* extraction of raw materials	5.58	5.47	98
3. Jewelry mfg.	Jewelry work, mfg. of precious stones for clock and watch making, diamond cutting	.41	.38	93
4. Plumbing — including house connections — must include shop payroll	Installation of gas, water, electric and heating apparatus—no mfg. and no work outside building	1.13	3.21	284
5. Machine shops — with foundry	Foundries with machine shops and the mfg. of machine parts	1.48	3.58	242
6. Foundries — iron	Foundries for commercial castings, stoves, heating apparatus, furnaces, fittings, mechanical and structural castings	1.48	3.58	242
7. Rolling mills — operated in connection with steel works rolling products of every description, including rod mill	Rolling mills	2.92	4.53	155
8. Hardware mfg. n. o. c.	Hardware mfg.	.88	2.64	300
9. Motorcycle and motorcycle parts mfg. — including the assembling of motorcycles	Mfg. of automobiles, motorcycles and bicycles	1.03	3.02	293
10. Sewing machine mfg.	Mfg. of sewing machines, typewriters, calculating machines, cash registers, water and gas meters	.68	2.26	334
11. Clock mfg.	Clock mfg.	.85	2.26	266
12. Watch mfg.	Mfg. of watches by machinery —no mfg. of precious stones or watch crystals	.26	.38	146
13. Saw mills	Saw mills (more than 10 workmen) without accessory industries	5.82	6.42	110
14. Wool spinning and weaving — excluding shoddy mfg.	Spinning of combed wool	.68	1.13	166
15. Bakeries	Bakeries, including confectionery mfg.	.98	2.26	231
16. Quarries — with or without blasting — n. o. c.	Granite quarries	5.08	7.36	145
17. Wrecking (not marine) no blasting	Demolition operations	13.35	14.91	112

COMPARISON OF RATES (*continued*).

(1). New York Classification.	(2). Swiss Classification.	(3). New York Pure Premium.	(4). Swiss Pure Premium.	(5). Percentage of (4) to (3).
18. Masonry, n. o. c. (no blasting)	Masonry and concrete work *without* extraction of raw materials	5.08	4.53	89
19. Chauffeurs and chauffeurs' helpers—commercial—n. o. c.	Transportation of persons and merchandise by automobile.	1.08	4.53	419
20. Clerical office employees n. o. c..	Technical and commercial staff of large enterprises (more than 10 employees) not including shop work or outside duties	.06	.09	156

gross rates quoted in the New York manual. The figures in column (4) were computed by deducting 2 from the rate quoted in the Swiss tariff, dividing by 1.06, and expressing the result per 100 units of payroll.

RESERVES.

The Swiss Accident Insurance Institution is operated upon a capitalized as distinguished from an assessment basis, the premiums being intended to be adequate to cover the ultimate incurred loss arising by reason of accidents occurring during the period for which the premiums are paid. Hence it became of vital importance, for purposes of determining the liabilities of the Institution and equitably assessing the cost upon the various industries, to provide a method by which the total compensation probably payable in respect of any accident might be capitalized into one sum. Actuarially, this resolved itself into the problem of computing annuity values on the basis of assumed rates of death, remarriage and revision, and at a stipulated rate of interest. The reports wisely caution the reader to distinguish carefully between transactions involving a single annuity value and those extending to a group of annuities among which the law of large numbers will have scope for its operation. It is pointed out that in dealing with the value of a single case of permanent disability, for instance, it would be inequitable to adopt an average rate of mortality and an average probability of revision. In such event, on the contrary, the condition of health of the injured person should be examined

into and the likelihood of a change in his degree of disability specially considered, and these factors taken into account in estimating the real commuted value of the benefit.

Disability Cases.

No reference is made in the publications to the valuation of cases of *temporary* disability and it seems probable, therefore, that no tables for computing reserves on such cases have been compiled by the Institution.

With respect to cases of *permanent* disability it is to be remembered that under the Swiss law these cases are compensated for life on the basis of 70 per cent. of the wages where the disability is total, and in proportion to the adjudged degree of impairment in earning capacity where the disability is partial. Revision of the rate of compensation takes place at any time during the first three years after the accident and thereafter at the end of the sixth and ninth years. There is no schedule of specific dismemberment benefits such as is usual in the United States.

It is therefore evident that as respects permanent disabilities we are dealing with annuities whose values are dependent upon three basic factors:

(1) the rate of revision,
(2) the rate of mortality,
(3) the rate of interest.

The rates of revision adopted were those shown by an investigation into the rates of mortality and revision among disabled lives concluded in the year 1913 by the Austrian Department of the Interior and based upon the experience of the Vienna Accident Insurance Association. For the years of duration 4 to 9 inclusive the collective experience of the Austrian associations was utilized to obtain the rates of mortality and the experience of the Vienna Association to obtain the rates of revision. For the years of duration subsequent to the ninth, revision is no longer a factor in the reserves and the rates of mortality shown by the Swiss Population Table (Males) 1901–1910 were employed. Interest was in all cases taken at 4 per cent.

It was found that during the first three years of duration the reductions in annuity-payments caused by revision were so large as compared with reductions caused by the death of the annuitant

that the age of the annuitant was not a factor of importance in determining the value. Hence for this period the values were tabulated solely according to the duration or time elapsed since the accident.

From the fourth to the ninth years of duration the influence of revision continued to be of greater weight than the influence of mortality, and, accordingly, the values were tabulated not for single years of age but for groups of ages and for durations. Beginning with the tenth year revision ceases and the table assumes the usual form of an annuity table. Values are given for each year of age and the duration is disregarded.

The symbols employed by the Swiss actuaries in this connection are as follows:

x = age at date of accident,

n = year of duration,

$\bar{q}_x$ = probability of the termination of the annuity by death within one year,

$r_{x,n}$ = probability of the reduction of an annuity issued at age x by 1 through revision during the nth year of duration,

p_x = the probability that the life (x) will survive one year.

Then

$u_{x+n,n} = 1 - \bar{q}_{x+n} - r_{x+n,n}$ = the probability at the commencement of the nth year that 1 will be payable at the end of the year.

(For the first two years a table of u_m is given showing the probability at the beginning of the mth month that 1 will be payable at the end of the mth month.)

R_m = the present value of a disability annuity of 1, during the first 3 years of duration, where m denotes the quarter or year of payment.

$R_{x+n,n}$ = the present value, for the 4th to 9th years of duration, of an annuity of 1, where x is the age as of date of accident and n denotes the year of payment.

R_x = the present value, for the 10th year of duration upward, of an annuity of 1, where x = current age attained at date of valuation.

Tables of the elementary functions u_m, q_{x+n}, $u_{x+n,n}$ and p_x are given in the report.

The values of disability annuities for the first three years are given in Table A.

TABLE A.

PRESENT VALUE OF DISABILITY ANNUITIES FOR AN ANNUAL SUM OF "1" PAYABLE MONTHLY IN ADVANCE.

Disability Annuities for the First Three Years (R_m).

m = quarter or year of payment of annuity.

$R_{i.}$	$R_{ii.}$	$R_{iii.}$	$R_{iv.}$	$R_{v.}$	$R_{vi.}$	$R_{vii.}$	$R_{viii.}$	$R_{3.}$
6.5912	7.1289	8.1664	9.2369	10.103	10.867	11.650	12.353	12.929

Thus, if the award were for 1,000 francs per annum the reserve at the end of the 3d quarter would be 1,000 × 8.1664 or 8,166.4 francs. At the end of the 7th quarter it would be 1,000 × 11.650 or 11,650 francs. At the end of the 3d year it would be 1,000 × 12.929 or 12,929 francs.

The values of the disability annuities for the 4th to 9th years are given in Table B.

TABLE B.

DISABILITY ANNUITIES FROM THE 4TH TO THE 9TH YEAR OF PAYMENT.

($R_{x+n,\ n.}$)

x = original age at entry of annuitant.

n = year of payment.

$x.$	$R_{x+4,\ 4.}$	$R_{x+5,\ 5.}$	$R_{x+6,\ 6.}$	$R_{x+7,\ 7.}$	$R_{x+8,\ 8.}$	$R_{x+9,\ 9.}$	$x.$
-19	17.394	17.227	17.052	18.192	18.067	17.937	-19
20-24	16.827	16.638	16.439	17.505	17.351	17.191	20-24
25-29	16.020	15.797	15.566	16.495	16.311	16.126	25-29
30-34	14.980	14.736	14.489	15.295	15.102	14.912	30-34
35-39	13.823	13.573	13.322	13.993	13.794	13.596	35-39
40-44	12.618	12.363	12.105	12.612	12.401	12.189	40-44
45-49	11.408	11.143	10.874	11.203	10.969	10.734	45-49
50-54	10.162	9.8841	9.6002	9.7625	9.5044	9.2456	50-54
55-59	8.8478	8.5555	8.2618	8.2505	7.9876	7.7324	55-59
60-64	7.4152	7.1373	6.8660	6.7576	6.5205	6.2879	60-64
65-69	6.1180	5.8461	5.5808	5.3688	5.1279	4.9025	65-69
70 and over	4.7429	4.5077	4.2882	4.0863	3.9031	3.7393	70 and over

Thus, if the award were for 1,000 francs per annum, the original age at entry 35, the reserve at the end of the 7th year would be 1,000 × 13.993 or 13,993 francs.

Where the duration is over 10 years the values of the annuities are determined by reference to an annuity-table of the usual form giving values for each age attained at date of valuation.

Death Cases.

The valuation of the Swiss death benefit involves the determination or assumption of three basic factors, as follows:

(1) the rate of remarriage,
(2) the rate of mortality,
(3) the rate of interest.

The remarriage table adopted was that of the Dutch Royal Insurance Institution (1912), already familiar to compensation actuaries in this country. For mortality the Swiss Population Table (Male and Female) 1901–1910 was taken. The rate of interest assumed was, as in the case of disability annuities, 4 per cent.

Since under no circumstances is the death benefit under the law to exceed 60 per cent. of the wages, and since it is only necessary that there be a widow and two children in order that the limit may be reached, it follows that "limit cases" are very frequent. The liberal character of the benefits to ascendants tends to increase this effect. A strictly accurate valuation of such cases involves, as is well known, complications of probabilities which cannot be handled in practice save by the use of approximations and simplifying assumptions. The problem is to reach a solution which will be practical and at the same time sufficiently accurate.

The general method of procedure folowed by the National Institution was to divide every benefit involving the application of the 60 per cent. limit into two parts, (1) a "family annuity" continuing up to the time when, by reason of the attainment of age 16 by the "significant child," the limit is no longer operative and (2) deferred individual annuities for the remainder of the benefit. The family annuity is taken to be simply an annuity-certain for a term equal to 16 minus the age at entry of the significant child. Probabilities of mortality and remarriage are disregarded for this period.

The symbols employed are as follows:

F_z = the present value of a family annuity of 1 per annum payable monthly in advance, where
z = the age at entry of the significant child,
$W_{x,z}$ = a deferred annuity to the widow of 1 per annum, where
x = the age at entry of the widow,
$K_{x,z}$ = a deferred annuity to children or brothers and sisters of 1 per annum, where

x = the age at entry of the child entitled to the annuity,
$A_{x,\ s}$ = a deferred annuity to ascendants of 1 per annum, where
x = the age at entry of the annuitant,
W_x = an immediate annuity to the widow at the attained age x,
K_x = an immediate temporary annuity to a child at the attained age x for the term $16 - x$,
A_x = an immediate annuity to ascendants at age attained x.

Tables of values of all the foregoing functions are given in the report. As an illustration of their use we may assume the following case.

Age of widow	35
Age of children	9, 6, 3
Age of mother	65

Here the total compensation otherwise payable would be

	Per Cent.
Widow	30
Children	45
Mother	20
Total	95

It is evident that not until the attainment of age 16 by the youngest child (3) will the effect of the 60 per cent. limit cease to be operative. Hence (3) is the "significant child." The value of the benefit per 1,000 francs annual wages is therefore

$$600F_3 + 300W_{35,\ 3} + 200A_{65,\ 3} = 600 \times 9.8971 + 300 \times 5.2185 + 200 \times 1.0479 = 7{,}713.39.$$

Although the law provides that a child orphaned of both parents shall receive 25 per cent. of the wages as compensation, it appears from the form of the tables that either this benefit is held to apply only when the child is orphaned at the time of the accident and not when subsequently orphaned through the death of the surviving parent or that the probability of the increase in compensation from 15 to 25 per cent. through the death of the surviving parent is ignored in computing the present value.

Bases of Valuation.

In the selection of standards of valuation the danger of a systematic and continuous adverse change in the rates of mortality,

remarriage, or in the experience as to revision was borne in mind, and to offset the danger from this source a margin of safety was added to the net premium amounting to 4 per cent. This point has been previously referred to in discussing the computation of premiums. With regard to the rate of interest assumed the following paragraph is quoted from the report.

"Regarding the rate of interest at which the funds are to be accumulated, the matter is a difficult one to forecast at the present day. It seems evident that during the next 5–10 years considerably over 4 per cent. can be obtained, which very likely will afterward gradually fall toward this rate. In any event, the present values during the next 5 years can easily be invested at 4 per cent., which interest basis corresponds to the Dutch and Austrian assumption in the case of state accident insurance and also to that of the 'Leipzig' and 'Gotha' private insurance companies."

The use of a mortality table showing rates of mortality among the general population may perhaps be criticized as tending to produce somewhat low annuity-values, for although these annuitants are not self selected, a tendency to superior longevity seems a characteristic of annuitants of all types. The great element of uncertainty in all such calculations, however, lies in the remarriage rates assumed. Among other considerations, it seems not improbable that one of the social after effects of the war will be to reduce rates of remarriage among widows. In view of all the facts, it seems important that standards of valuation hereafter adopted for similar purposes in this country should be more stringent than those of the Swiss Accident Insurance Institution. As to *methods,* however, considered apart from specific standards, American compensation actuaries may profit greatly by a close study of this material which comes to us from a sister republic.

NOTE ON THE CONSTRUCTION OF MORTALITY TABLES BY MEANS OF COMPOUND FREQUENCY CURVES.*

BY

ARNE FISHER.

In the following pages I shall attempt to give a brief outline of a method of constructing a mortality table from the records of death by age and cause, but without knowing the exposed to risk at various ages. The method may to some appear new and revolutionary, and perhaps a few may assert it is impossible to construct a life table from such data alone without knowing the age distribution of the exposed to risk. It has, however, been done before, although by different methods than those I propose to employ.

The Danish Actuary, Dr. Phil. Jens Pedersen, in a brochure on "The Insurance of Substandard Lives" constructed special mortality tables for three separate danger classes of substandard risks, using certain Danish census data, giving the number of deaths in Danish cities and towns by cause and by age. Pedersen starts with certain hypotheses about the continuity of the danger regions and makes use of the differential geometry in his solution.

Karl Pearson, the eminent English biometrician, in a brilliant essay in his "Chances of Death" attacked the problem by frequency curve methods. Pearson took the numbers dying at various ages and analyzed the series into the sum of five frequency curves typical of old age, middle life, youth, childhood and infancy. Mr. Robert Henderson in his treatise on "Mortality and Statistics" claims that "it is difficult to lay a firm foundation for the method, because no analysis of the deaths into natural divisions by causes or otherwise has yet been made such that the totals in the various groups would conform to these frequency curves."

This statement evidently contains a half truth if we limit ourselves to the Pearsonian system of 7 types of frequency curves, which by no means suffice for all frequency distributions, occurring in practise. I have in fact in my statistical work encountered

* In part from a chapter of the author's forthcoming second volume of The Mathematical Theory of Probabilities (Macmillan Co., New York).

many statistical series which offer an absolute defiance to the Pearsonian curves. We will in general on the other hand succeed in fitting the curves if we instead of the Pearsonian method make use of the system of frequency curves originally introduced by Laplace and Poisson and of late years further developed by Charlier. I hope indeed in the following to show that it is possible to analyze the series of deaths into a system of 8 Laplacean-Charlier and Poisson-Charlier frequency curves, typical of distinctive groups of causes of deaths at various stages of life.

The Laplacean theory, the oldest and most general theory of frequency curves, assumes that any frequency curve is generated as the sum of different and independent frequency curves, generally infinite in number. It is on the basis of this hypothesis that I propose to analyze the series of deaths at various ages into 8 separate component frequency curves, typical of distinctive causes of death.

To start with fundamental principles let us consider the frequency of deaths at various ages out of an original cohort of say 10,000 persons, all entering under our observation at age 10. The question before us is: "How will those entrants gradually die off?" We will have a few deaths at age 10, these deaths slowly increase to age 20, then the increase becomes more rapid—although by no means uniform—until we reach the ages around 70, where we encounter a maximum. From age 70 and on the numbers of deaths rapidly decline, until at the age of 100 only a few survivors of the original cohort struggle along. Ultimately all are carried off by death at age 110 or so. Graphically this series—simply the d_x column of a mortality table—represents a compound curve with a high crest around age 70, gradually diminishing towards youth and old age. From 70 and on the curve resembles to a very high degree the right half of the Normal Laplacean or Gaussian Law of Error. This fact was already noticed by Lexis, who through an application of his dispersion theory analyzed the extreme right part as a normal curve with a maximum and mean in the neighborhood of age 70. Pearson went further and made a complete analysis of the remaining part of the curve.

My hypothesis is now that the numbers of deaths from specific causes cluster around certain definite ages in such a manner that the frequency distribution according to age from a specified cause or group of causes of death may be represented by a typical skew frequency curve of either type A (Laplace-Charlier Type) or type

B (Poisson-Charlier Type).* We will, for instance, notice that deaths from cancer and heart disease, etc., amongst the survivors at various ages of the original cohort are most frequent in the age period 65–70. Tuberculosis, on the other hand, levies its heaviest toll around the age interval 35–40. The first step is now to group the deaths arising from certain diseases in such a way that their sum total represents a frequency curve of either type A or type B. This classification or grouping is done by the aid of the Lexian-Charlier dispersion theory and by methods exactly like the ones described in my recent paper in the *Proceedings* (Vol. III, p. 241) on the construction of basic pure premiums. Through gradual tests I succeeded in getting the following 8 fairly typical groups.

B. Deaths typical of youth.
C. Deaths from industrial accidents, typhoid fever, etc.
D. Deaths from pulmonary tuberculosis, etc.
E. Deaths typical of middle life.
F. Deaths typical of late middle life.
G. Deaths typical of early old age.
H. Deaths typical of middle old age.
I. Deaths typical of extreme old age.

I do not claim those groups as being the final word. Probably the scheme might be further improved by decomposing group G

* The A type is given by the equation:

$$F(x) = \varphi(x) + \beta_3\varphi^{III}(x) + \beta_4\varphi^{IV}(x) + \cdots$$

where

$$\varphi(x) = \frac{1}{\sigma\sqrt{2\pi}}\, e^{-(x-M)^2/2\sigma^2}$$

is the ordinary probability function expressed in units of the dispersion, ϕ^{III}, ϕ^{IV}, ..., its various derivatives, and M, σ, β_3, β_4 certain parameters, independent of the variate x; e is the logarithmic base. M is known as the mean, σ is commonly called the dispersion, β_3 the skewness and β_4 the excess.

The B type progresses by a finite difference formula of the following form: $F(x) = \psi_\gamma(x) + \gamma_2\Delta^2\psi_\gamma(x) + \gamma_3\Delta^3\psi_\gamma(x) + \cdots$, where the generating function now is:

$$\psi_\lambda(x) = \frac{e^{-\lambda}\lambda^x}{\underline{|x}},$$

or the Poisson exponential. λ and γ_2 are again certain parameters determined from the observations. The various parameters are throughout this paper computed by means of the well-known method of moments, that of least squares, or by the methods of Dr. Thiele's half invariants.

into at least two or three subgroups. A detailed and complete dispersion test would take considerable time, which at present, on account of other and more urgent work, is not at my disposal. However, the above grouping represents the most important factors in the generation of the total compound frequency curve, or the d_x column of the mortality table. I shall therefore proceed to apply the above classification to the deaths from the United States Registration Area for the year 1910 as recorded by age and cause of death in the volume "Mortality Statistics," published by the Federal Census Bureau, and construct a mortality table for white males for this area.

The computation of the various statistical parameters of the 8 curves by means of the well known method of moments gave the following results for the above mentioned material.

		Mean.	Dispersion.	Skewness.	Excess.
B type	B.....	Constructed by Jörgensen's method for quinquennial age groups and interpolated for single ages by Novalis' formula.			
	C.....				
A type	D.....	44.3	16.306	−0.04465	−0.03344
	E.....	52.7	18.776	+0.02304	−0.02900
	F.....	59.7	17.110	+0.10812	−0.00705
	G.....	66.8	14.110	+0.15857	+0.05172
	H.....	71.3	14.587	+0.15992	+0.03773
	I.....	78.3	10.483	+0.15319	+0.06847

These parameters determine the equations for the various frequency curves $F(x)$, but it must be remembered that they give us only the form of distribution or the clustering tendency around the mean and no clue whatsoever as to the number of individual deaths in a particular group. In other words, we do not know the area of the curves themselves.

Let N_B, N_C, N_D, $\cdots$ N_I denote the areas of the various frequency curves and $N_A = 10{,}000$ be the area of the total compound frequency curve, i. e., the total number of deaths at various ages of quennial ages.

The total number dying at a particular age, say age x, will then according to our clustering hypothesis be:

$$d_x = N_B F_B(x) + N_C F_C(x) + N_D F_D(x) + \cdots + N_I F_I(x)$$

where

$$N_B + N_C + N_D + N_E + \cdots + N_I = N_A = 10{,}000.$$

In this equation we know the various values of $F(x)$ from the equation of the frequency curves, but none of the values of N, except $N_A = 10{,}000$.

Let us now for the present denote the proportionate mortality at a particular age or group of ages of any one of the above classes, say for instance class B, by $R_B(x)$. We have then for age x

$$R_B(x) = \frac{N_B F_B(x)}{N_B F_B(x) + N_C F_C(x) + \cdots N_I F_I(x)}.*$$

Similar proportionate rates can be found for the other classes of causes of death. Moreover, it is readily seen that the various values of $R(x)$ for the different age groups depend upon the deaths alone in those groups and are independent of the number actually exposed to risk, provided, of course, that our numbers of deaths are so large that fluctuations due to sampling may be ignored. Bearing in mind that $N_B + N_C + N_D + \cdots + N_I = N_A = 10{,}000$, we have thus a larger number of observation equations than we have unknown and from which the values of the N's may be determined by well known methods. The best way is probably to determine first approximate values for the unknowns, and then adjust those values by the method of least squares so as to make as close a fit as possible with the observed values of $R(x)$.

The compound frequency curve, or what is the same, the d_x column of the mortality table, is simply found by addition of the above eight component curves. The result is shown graphically in Fig. 1. The areas of the 8 component skew frequency curves bear the following ratios to the total area:

B	.028140	F	.149095
C	.049857	G	.435717
D	.092627	H	.071631
E	.096724	I	.076209

The values of q_x are easily computed from the d_x column or the compound frequency curve by forming first a column of l_x by summing the series of death at various ages as represented by the compound curve. The well known formula $q_x = d_x/l_x$ gives us then the values of q_x.

* It is readily seen that $R_B(x)$ represents nothing more than the probability that when a person is dead the cause of death arose from the group of causes which we have designated by B.

Mortality by Age and Typical Causes

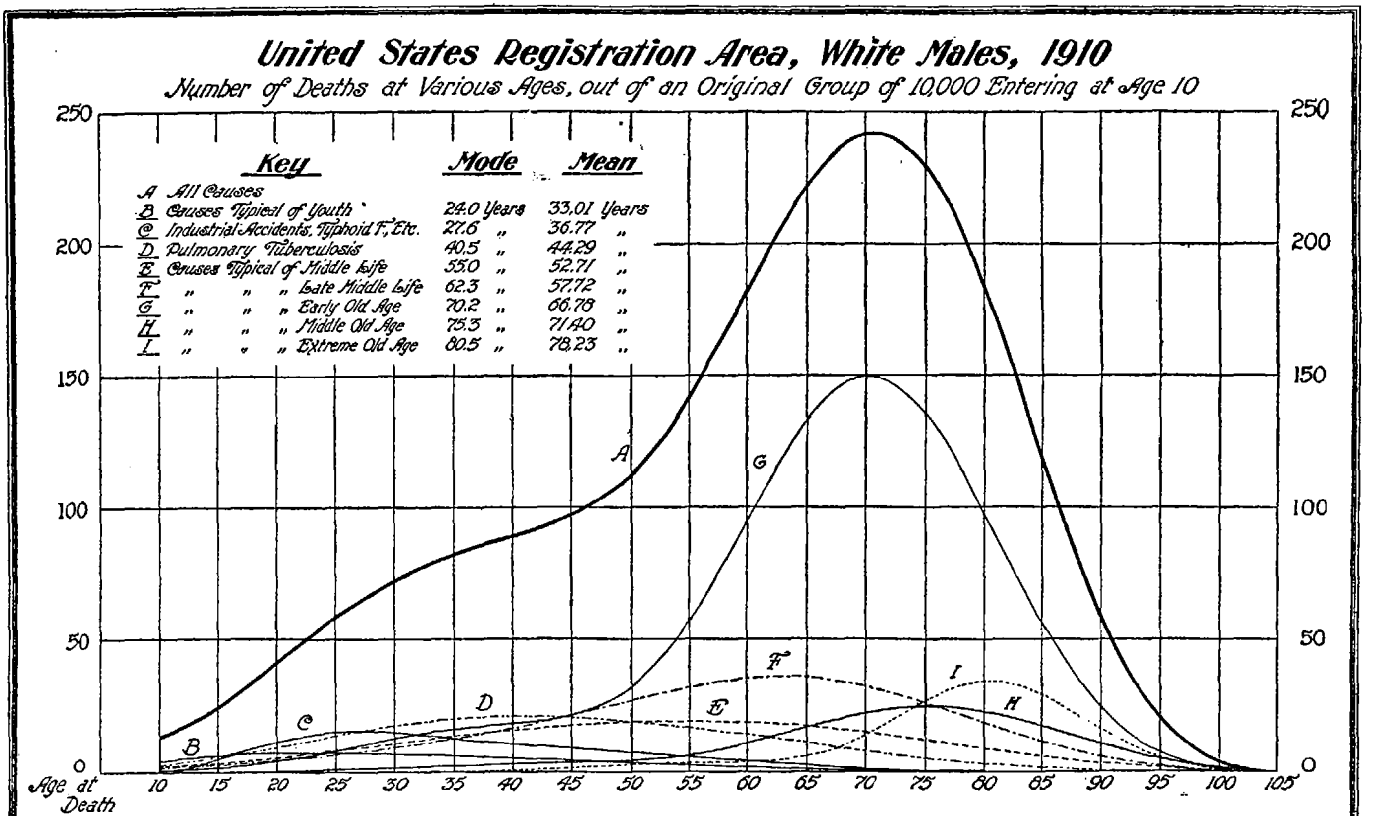

FIG. 1.

For comparative purposes I give below the values of the function q_x alongside the values of the Glover Table for White Males in the Original Registration Area.

TABLE OF VALUES OF $1{,}000q_x$ FOR WHITE MALES CONSTRUCTED FROM THE COMPOUND FREQUENCY CURVE AND CORRESPONDING VALUES OF THE GLOVER WHITE MALES TABLE.

Age.	New Table.	Glover Table
20	4.31	4.89
25	6.17	5.54
30	7.86	6.60
35	9.38	8.52
40	10.71	10.22
45	12.37	12.64
50	15.30	15.53
55	21.09	21.50
60	30.63	30.75
65	44.45	43.79
70	63.11	62.14
75	89.49	92.53
80	118.28	135.75
85	157.96	191.11
90	210.56	255.17
95	282.97	324.86
100	386.71	427.46
105	448.71	582.65

There are, of course, slight discrepancies in the two tables, what indeed might be expected. The Glover Table was constructed on the basis of the estimated population exposed to risk in the *original registration states* and the deaths at various ages for the years 1909, 1910 and 1911, whereas my table was derived from the deaths by cause and age only for the year 1910 for the *total registration area.* A state like Pennsylvania, where for younger ages the accidents from coal mining and other industries are rather high, is not included in the Glover Table. This in connection with the comparatively small area of the southern states included in my table probably accounts for the slight variations. Taken as a whole the two tables show, however, a close agreement, which perhaps may serve as a good test for the validity of the proposed method.

One serious defect I wish, however, to point out in this discussion in connection with the frequency curve of causes of deaths under class C, comprising chiefly deaths arising from occupational hazards. The fit of this particular curve is not very good. It was

fitted as a single curve of type B, whereas as a matter of fact it represents a compound curve of two separate curves of which one is a decidedly skew curve of type B and the other a curve of the regular A type. In a table for the total population this defect may not be so serious since the total area of this particular curve is relatively small as compared with the curve areas of causes of deaths in the other classes. In occupations with a pronounced occupational hazard the matter is, however, quite different since the area of this particular curve is of considerable importance as compared with the areas of the other curves, and the total effect in the compound curve tends to give too low mortality in the ages from 15 to 24 and too high a mortality in the ages from 25 to 32. These remarks must be borne in mind in connection with the discussion immediately following.

I shall now, furthermore, as an additional illustration of the method, show how we may construct an occupational mortality table for so distinctive an occupation as that of locomotive engineers. The statistical data forming the basis of this table have most kindly been put at my disposal through the courtesy of Mr. F. S. Crum, assistant statistician of the Prudential Insurance Company of America, who secured the records of deaths by age and cause from more than 7,000 death claims of the "Locomotive Engineers' Mutual Life and Accident Insurance Association" as published in the *Locomotive Engineers' Journal* for the years 1907–1916.

Through a test by correlation methods I found that the parameters to all practical purposes remained essentially unaltered in the various groups, except possibly in groups F and C. The areas of the component curves are, however, quite different from the component areas in the general population as shown by the following table.

TABLE SHOWING RATIO OF AREAS OF COMPONENT CURVES OF LOCOMOTIVE ENGINEERS TO THE CORRESPONDING COMPONENT AREAS OF THE 1910 WHITE MALES IN THE REGISTRATION AREA.

Groups.	Ratio.	Groups.	Ratio.
B	0.2495	F	0.7834
C	3.7988	G	1.0345
D	0.2628	H	0.9639
E	0.7150	I	0.9642

Mortality of Locomotive Engineers. 1907–1916

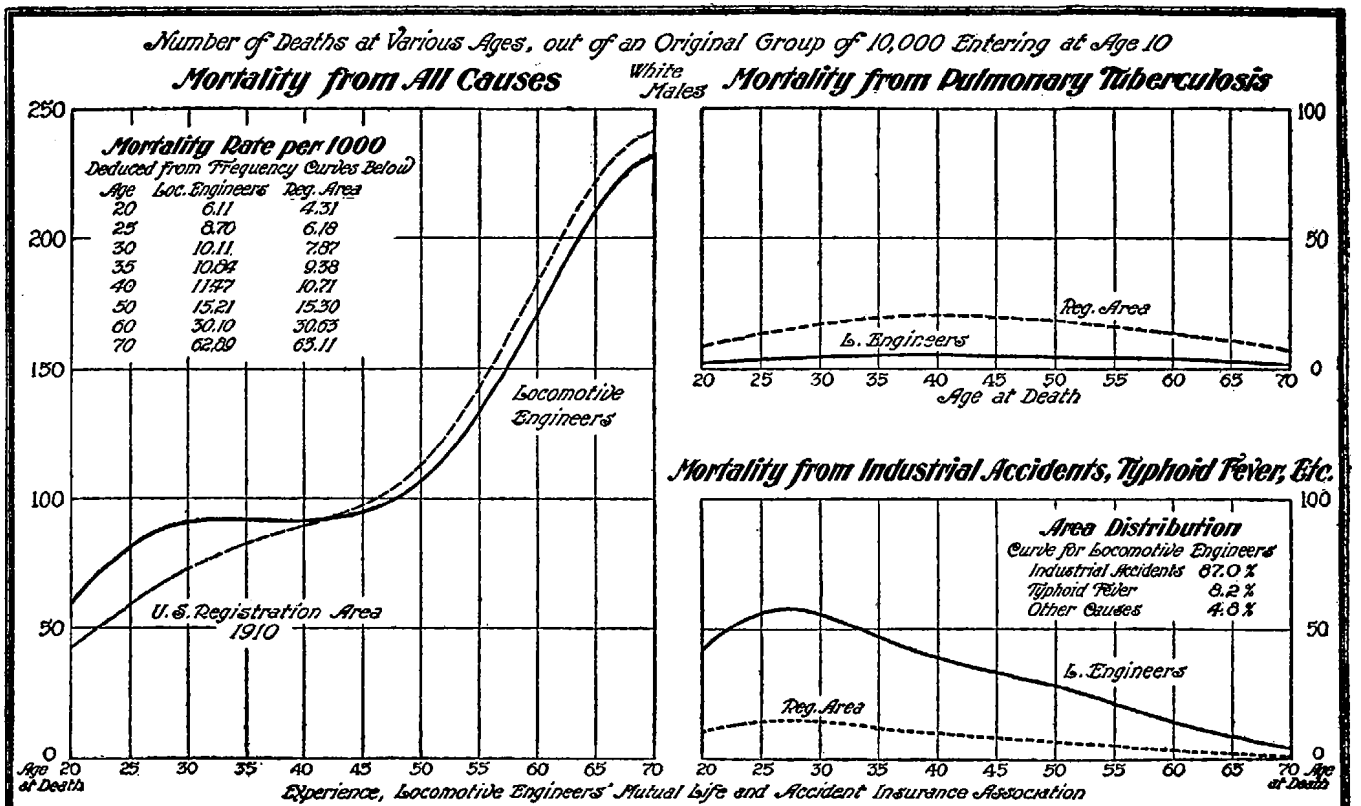

FIG. 2.

This shows that the area of group C, representing deaths chiefly from industrial accidents and typhoid fever, is about 3.8 as great as the corresponding area in the general population, whereas tuberculosis, chiefly represented by curve D, is only about one fourth of that of the general population. This relation is shown graphically in Fig. 2. The same figure shows also the compound frequency curves for locomotive engineers as compared with the general population in the age interval from 20 to 70. The total area of the compound curves for the full span of life must of course be the same for both tables, although differing greatly in a specific age interval. From the compound curve for locomotive engineers I constructed the values of q_x, of which I submit a table for quinquennial ages.

VALUES OF $1000q_x$: LOCOMOTIVE ENGINEERS.

Age: x.	$1000q_x$.	Age: x.	$1000q_x$
20	7.02	50	16.14
25	7.98	55	21.76
30	8.59	60	31.47
35	10.01	65	44.10
40	11.47	70	61.97*
45	13.20		

ADDENDA.

Since the writing of the above article I have made a further study of the stability of the various groups of causes of death. As mentioned previously it is desirable to break up group G in at least two groups. Moreover, by making extended tests for stability, it is of course possible to reach more desirable combinations than the ones originally chosen for the eight groups.

Although the various tests by means of the Lexian-Charlier dispersion theory are not fully completed, I take the liberty to submit the following preliminary scheme of 10 groups, together with the numerical values of the various statistical parameters:

* I wish here to remark that the defect in the frequency curve C in all probability has caused a rise in the mortality rates from ages 25 to 40, while the mortality is too low in the ages below 25. In order to emphasize this I have purposely retained the figures in this paper in order to compare them with a later, and I hope more successful, analysis of the same data given below.

Group.	Mean.	Dispersion.	Skewness.	Excess.
A	(All causes in the compound curve)			
B	Fitted by means of Poisson-Charlier B curves			$\lambda = 1.5$
C	for 5 year intervals			$\lambda = 2.1$
D	47.21	14.935	−0.0554	−0.0129
E	40.20	16.359	−0.0406	−0.0286
F	52.28	19.602	+0.0219	−0.0332
G	59.19	18.288	+0.0806	−0.0176
H	64.21	14.578	+0.1193	+0.0256
I	66.93	13.739	+0.1140	+0.0373
J	71.87	13.251	+0.1522	+0.0160
K	77.80	10.328	+0.1408	+0.0488

As an additional illustration of the method I shall try to regraduate the United States Life Table for all Males in the Original Registration States as constructed by Professor James W. Glover from the census of 1910 and the deaths in 1911, 1910 and 1909. We have in this case simply to break up the d_x column of the Glover Table into 10 separate columns as represented by the proportionate mortality of the above groups.

As a matter of illustration let us take the age interval 50–54. According to the census reports the total number of deaths from all causes during 1909, 1910 and 1911 in this interval amounted to 71,252, distributed according to our scheme of classification of causes of death as follows:

Class B	460
C, D	4379
E	11110
F	9197
G	7827
H	20688
I	14130
J	2098
K	1352
	71252

The total number of deaths according to Glover in the same age interval and based upon a radix of 1,000,000 survivors at age 10 is 63,361. Assuming that the proportionate mortality in the Glover Table is the same as in the general population, an assumption which probably is justified, we obtain the following pro rata distribution according to the various classes of deaths:

Class B	418
C, D	3897
E	9878
F	8180
G	6963
H	18394
I	12564
J	1863
K	1204
	63361

Continuing in the same manner for the other age intervals we get a series of columns representing the deaths at various ages in the 10 classes from B to K. Summing up these columns we obtain the area of the various curves expressed in the total number of deaths from the specific groups for all ages. These numbers are then simply multiplied with the equations of the frequency curves for the respective groups of the above classification. The final result is shown in the appended table. (Table I.)

It will now be of interest to make a comparison between the values of q_x as constructed by means of frequency curves and the original values in the Glover Table.

Age.	Glover's q_x.	Fisher's q_x.
10	2.42	1.26
15	2.91	2.95
20	5.03	4.41
25	5.71	5.49
30	6.81	6.81
35	8.74	8.47
40	10.46	10.31
45	12.84	12.72
50	15.81	16.58
55	21.78	22.85
60	31.04	32.40
65	44.06	45.51
70	62.40	62.75
75	92.72	85.64
80	135.64	115.01
85	190.94	151.21
90	253.85	196.12
95	321.76	258.96
100	407.20	359.02
105	526.33	527.27

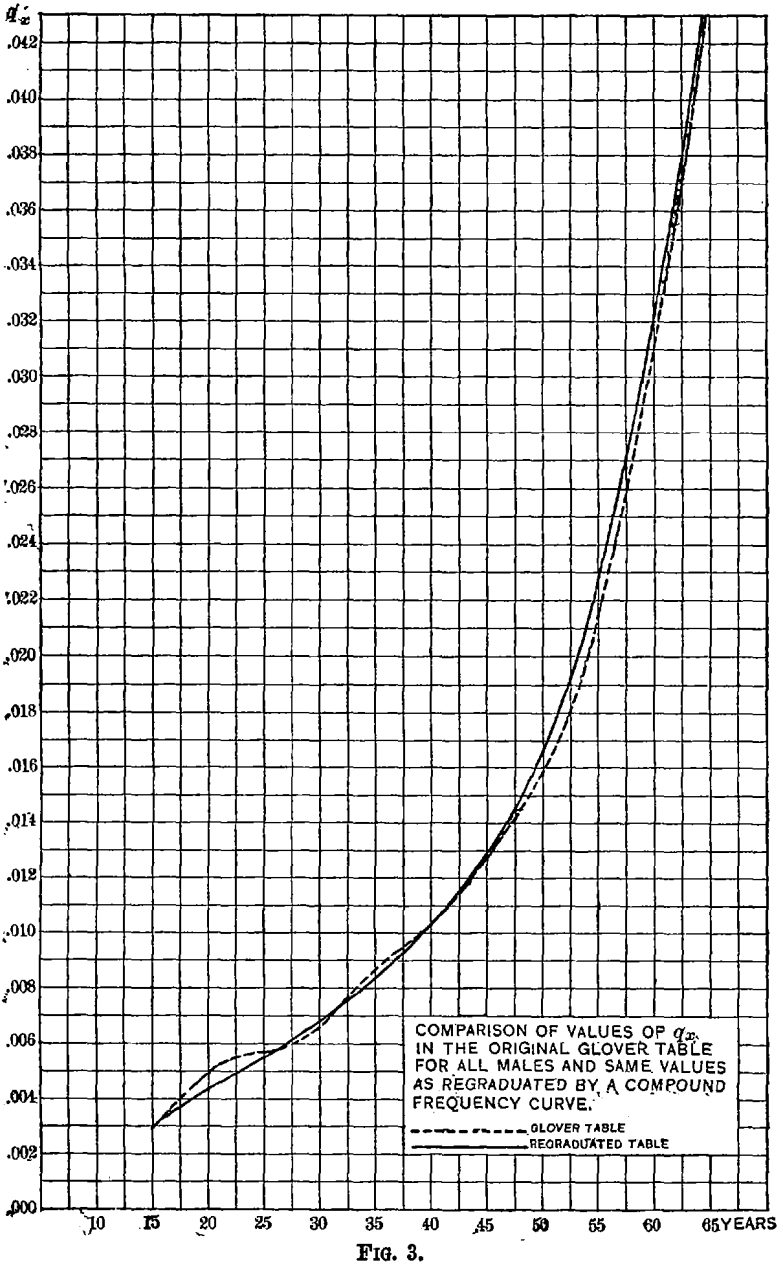
q'_x
.042
.040
.038
.036
.034
.032
.030
.028
.026
.024
.022
.020
.018
.016
.014
.012
.010
.008
.006
.004
.002
.000
10
15
20
25
30
35
40
45
50
55
60
65 YEARS
COMPARISON OF VALUES OF q_x IN THE ORIGINAL GLOVER TABLE FOR ALL MALES AND SAME VALUES AS REGRADUATED BY A COMPOUND FREQUENCY CURVE.
GLOVER TABLE
REGRADUATED TABLE

FIG. 3.

The larger discrepancies are all in the older ages and in the ages 10–12. The deficiency in the younger ages arises from the fact that the truncated tail end of the B curve of infant mortality reaches into that age period. This curve is not included for ages below 10. The truncated tail end was fitted as a B curve, which gave too low values for the ages 10, 11, 12 and 13 and slightly too high values for the remaining ages. This deficiency is, however, of no practical importance, because of the fact that this particular curve plays no part whatsoever in the ages above 20.

The discrepancies for older ages are at a first sight of a more serious nature. It must, however, be borne in mind that the mortality table for ages beyond 80 is liable to violent perturbations, and no mortality table can lay claim to being exact for those higher ages. Moreover, the frequency curve for extreme old age includes deaths, which in the census reports are classified as due to senility. The number from this cause is quite large. Now whenever senility is given as the cause of death that is probably due to a defective medical diagnosis of the cause of death, which probably was due to a well-defined disease, such as Bright's disease, heart disease, apoplexy, etc. This fact will of course influence the area of the curves including such causes of death, which wrongly are termed senility. I am at present working on the British mortality statistics and hope from the facts contained therein to throw further light on this question.

For practical purposes and rate-making the fit of the various values of q_x for higher ages is of less importance, and the fact that construction of the q_x by means of compound frequency curves for the ages between 15 and 75 shows a remarkable close fit to the original Glover figures seems to me but further evidence of the soundness of the method.*

* As another example of the regraduation of a mortality table we may mention the graduation of the American Experience Table of Mortality by Mr. Arthur Hunter by the Makeham hypothesis. This regraduation is of course nothing more than the fitting of precision observations, assuming the original values of the American Table to be the original observed values of the unknown. Nevertheless Mr. Hunter's table shows for younger ages as large percentage deviations from the original values as the present method of frequency curves, and when it is subjected to the test of stability by dispersion methods the Hunter graduation can by no means be said to be beyond the pale of criticism.

Mortality by Age and Typical Causes

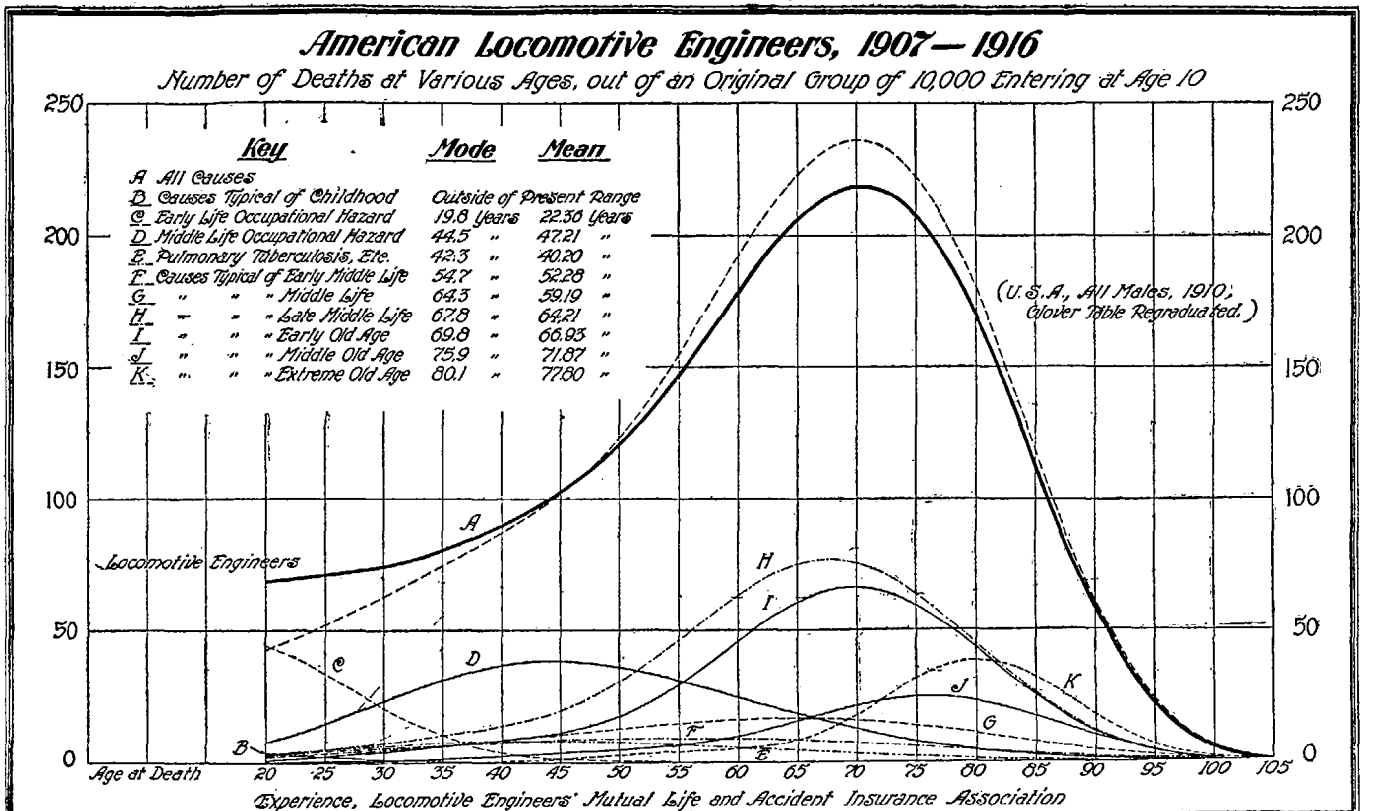

FIG. 4.

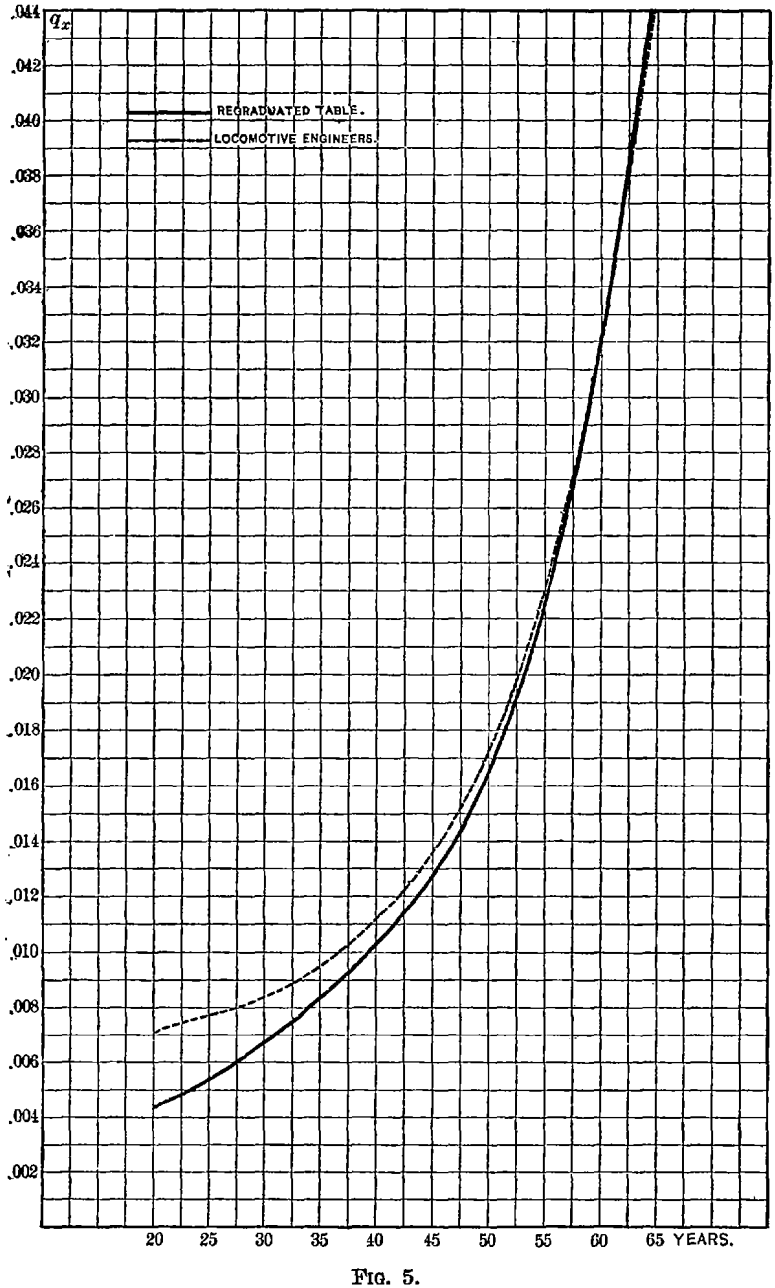

FIG. 5.

Value of q_x as computed from compound frequency curves, showing comparison between the regraduated Glover Table and Locomotive Engineers.

At any rate I trust by a further study of the excellent data contained in the British Register General's Report and additional Dutch, French, Swiss and Scandinavian data to be able to perfect the method for the component skew frequency curves typical of extreme old age.

The defect in the construction of a mortality table for Locomotive Engineers by the aid of the former method of 8 component curves was discussed above. I shall here give the results from an application of the 10 curves where the primarily occupational hazards are represented by curves C and D. The areas of the curves were determined by the usual methods of least squares, and the final result is shown in Table II. The same result is shown graphically in Fig. 4 together with the compound curve of the regraduated Glover Table. This table and the accompanying graph are presented without further comment as to possible merits or defects. I shall instead give a detailed comparison between the observed values of death records by age and cause of Locomotive Engineers and the corresponding values as obtained by frequency curves. Such a comparison is made possible by the following simple method. Choosing at random a certain age interval, say from 55–59, we find in the Locomotive Engineers' Table altogether 80,131 deaths distributed according to the frequency curves as follows:

Class B	0	%
C, D	14216	17.74
E	3126	3.90
F	4467	5.57
G	7729	9.65
H	26620	33.22
I	17855	22.28
J	3876	4.84
K	2242	2.80
Total	80131	100.00

The actual number of observed deaths in this interval was 870. A pro rata distribution according to the percentages above gives the following number in the 10 classes:

Class B	0
C, D	154
E	34
F	48
G	84
H	289
I	194
J	42
K	25
Total	870

The distribution actually observed according to the same classes of causes of deaths was as follows:

Class B	1
C, D	134
E	31
F	34
G	90
H	313
I	194
J	44
K	29
Total	870

A similar tabular arrangement is shown below for all age groups of the calculated (expected) and observed number of deaths in the various classes of deaths.

An actual test for the "goodness of fit" would take considerable time, and I leave it to my readers to form their own judgment as to the actual success of the construction on the basis of the above tabular arrangement of observed and expected numbers of deaths.

The mortality tables as constructed by means of a few simple theorems from the mathematical theory of probabilities are here viewed in their actuarial aspect only. Much more interesting and weightier questions of a purely philosophical and biometric nature in connection with the study of human mortality must unfortunately be left out in this short article. The final values are the results of a purely deductive analysis by means of mathematical methods. *We must, however, not forget that the deduction was founded upon a hypothesis as propounded at the beginning of this note.* If it can be proven that this hypothesis is wrong, none of the

OBSERVED AND CALCULATED (EXPECTED) DEATHS ACCORDING TO TYPICAL CAUSES. (LOCOMOTIVE ENGINEERS).

	20–24.		25–29.		30–34.		35–39.		40–44.		45–49.	
	Obs.	Calc.	Obs.	Calc.	Obs.	Calc.	Obs.	Calc.	Obs.	Calc.	Obs.	Calc.
K	—	—	0	0	2	0	1	2	8	8	9	17
J	—	1	1	1	12	8	26	19	26	29	37	37
I	—	—	6	9	26	38	64	70	97	95	142	125
H	1	1	9	16	36	64	100	114	166	161	239	222
G	2	1	11	11	48	41	65	73	85	95	80	108
F	—	1	18	14	43	46	63	70	80	78	70	80
E	1	1	21	15	60	52	81	77	83	82	67	74
C&D	16	14	131	128	344	321	431	405	410	409	379	361
B	0	1	1	4	4	5	1	2	2	0	1	0
	20		198		575		832		957		1024	

	50–54.		55–59.		60–64.		65–69.		70–74.		75–79.		80 and Over.	
	Obs.	Calc.	Obs.	Calc.	Obs.	Calc.	Obs.	Calc.	Obs.	Calc.	Obs.	Calc.	Obs.	Calc.
K	23	26	29	24	19	19	30	26	24	27	25	25	40	32
J	46	43	44	42	37	40	37	39	28	27	12	18	13	18
I	168	172	194	194	177	169	139	137	80	76	44	38	26	27
H	297	289	313	289	226	223	159	164	78	84	35	41	16	27
G	109	108	90	85	48	53	42	35	25	18	18	11	17	9
F	74	70	34	48	36	28	16	17	7	9	4	4	5	4
E	51	57	31	34	18	17	5	8	7	3	2	1	1	1
C&D	265	270	134	154	59	71	31	34	7	12	1	3	2	2
B	2	0	1	0										
	1035		870		620		459		256		141		120	

	Obs.	Per Cent.	All Ages.		Obs.-Calc.	Diff. in Per Cent. of Obs.
			Calc.	Per Cent.		
K	210	2.95	206	2.90	+ 4	1.90
J	319	4.49	321	4.52	— 2	0.62
I	1163	16.36	1150	16.18	+ 13	1.12
H	1675	23.56	1695	23.85	— 20	1.19
G	640	9.02	648	9.12	— 8	1.25
F	450	6.33	469	6.59	— 19	4.22
E	428	6.02	422	5.94	+ 6	1.39
C & D	2210	31.10	2184	30.73	+ 26	1.18
B	12	0.17	12	0.17	+ 0	0.00
Total.....	7107	100.00	7107	100.00		

results will be valid in general. On the other hand, the progress of the most exact sciences as those of physics and chemistry has shown that deductive mathematical reasoning based upon a sound and true hypothesis leads to more general and trustworthy results than the ones obtained by means of purely empirical methods, which in my opinion have been employed by far too great an extent

by actuaries and statisticians, and unfortunately at the loss of sound logic and common sense reasoning. Too many actuaries labor still under the fallacious ideas of John Stuart Mill that it is possible to deduce the corpus of human knowledge by what he termed an "*inductio per simplicem enumerationem.*"

In the meantime I beg my readers to remember and bear in mind the very scant and imperfect data I have had at my disposal and which nevertheless by a purely mathematical analysis have yielded plausible results, which certainly never could have been obtained by ordinary actuarial methods. If American actuaries in the future should turn their attention to the application of frequency curves and modern statistical methods, I can only wish that the above remarks may prove a modest step in the final solution of the problem of the construction of mortality tables along purely deductive mathematical lines.

Considering the fact, however, that I have had at my disposal death records only and not the slightest clue as to the age distribution of the numbers exposed to risk at various ages, I may perhaps be justified in advocating the use of modern statistical-mathematical methods in such actuarial practice, where the conventional methods leave us at a complete loss as to actual results. Moreover, I may in conclusion perhaps be allowed to assert that the results I have obtained from the use of mathematical-statistical methods do at least entitle such methods to a fair and impartial consideration instead of being looked upon with distrust and as having a theoretical interest only.

As a conclusion to these brief remarks I take great pleasure in acknowledging my thanks to a number of friends and statistical confrères who have given me valuable help in this little study on mortality. To Mr. F. L. Hoffman, statistician of the Prudential Insurance Company of America, and to Mr. F. S. Crum, assistant statistician of the same company, my most grateful thanks are due for the generosity with which they have put the necessary statistical material at my disposal. My thanks are also due to Mr. Knud Stoumann, formerly of the government statistical bureau of Copenhagen and now connected with the Prudential, who has rendered valuable assistance in the classification of the various causes of death, and to Mr. E. E. A. Fisher and Mr. C. Balck, also of the Prudential staff, for drawing the figures and making most of the extended numerical calculations in the actual construction of the tables.

TABLE I.

REGRADUATED LIFE TABLE FOR MALES IN THE ORIGINAL REGISTRATION STATES: 1910, SHOWING COMPOUND FREQUENCY CURVE OF NUMBER OF DEATHS BY VARIOUS AGES AND ITS 10 COMPONENT CURVES OF NUMBER OF DEATHS BY AGE AND TYPICAL CAUSES.

Age.	K.	J.	I.	H.	G.	F.	E.	D.	C.	B.	A, d_x.	l_x.	$1{,}000q_x$.
10			11	56	91	231	259	22	241	345	1,256	1,000,000	1.26
11			22	68	104	259	309	31	418	386	1,597	998,744	1.60
12			31	83	116	295	364	40	577	459	1,965	997,147	1.97
13			41	96	129	329	425	52	697	517	2,286	995,182	2.30
14			50	116	146	363	490	66	816	575	2,622	992,896	2.64
15			59	132	761	400	573	81	896	624	2,926	990,274	2.95
16			74	154	181	433	650	99	975	656	3,222	987,348	3.26
17			89	181	199	479	732	121	1,035	692	3,528	984,126	3.58
18			107	207	222	521	819	141	1,075	725	3,817	980,598	3.89
19		6	126	240	243	564	909	168	1,095	710	4,061	976,781	4.16
20		8	150	270	268	610	1,003	197	1,115	667	4,288	972,720	4.41
21		10	177	310	291	656	1,100	229	1,075	631	4,479	968,432	4.63
22		12	205	346	320	714	1,200	257	1,035	577	4,666	963,953	4.84
23		15	237	379	346	762	1,299	295	975	519	4,827	959,287	5.03
24		19	272	426	379	812	1,401	334	915	464	5,022	954,460	5.26
25		23	312	474	406	861	1,519	369	836	408	5,208	949,438	5.49
26		28	353	520	442	912	1,619	411	776	352	5,413	944,230	5.73
27		33	397	570	473	961	1,718	455	717	302	5,626	938,817	5.99
28		40	449	620	505	1,012	1,813	500	657	255	5,851	933,191	6.27
29		46	493	664	544	1,061	1,904	539	577	212	6,040	927,340	6.51
30		55	543	715	577	1,111	1,993	585	517	174	6,270	921,300	6.81
31		65	593	770	620	1,159	2,074	630	458	143	6,512	915,030	7.12
32		73	649	823	656	1,216	2,152	668	398	116	6,751	908,518	7.43
33		85	700	879	700	1,262	2,222	711	358	94	7,011	901,767	7.77
34		96	752	936	738	1,307	2,297	752	299	80	7,257	894,756	8.11
35	6	109	808	994	785	1,350	2,353	784	259	65	7,513	884,499	8.47
36	14	122	858	1,045	825	1,392	2,400	821	219	49	7,745	879,986	8.80
37	20	137	907	1,108	874	1,432	2,443	853	179	40	7,993	872,241	9.16
38	27	151	957	1,177	915	1,470	2,476	878	139	28	8,218	864,248	9.51
39	35	166	1,017	1,250	966	1,508	2,501	904	119	22	8,488	856,030	9.92
40	44	183	1,070	1,330	1,010	1,543	2,519	925	100	15	8,739	847,542	10.31
41	57	197	1,127	1,423	1,050	1,575	2,530	940	80	11	8,990	838,803	10.72
42	72	213	1,198	1,527	1,107	1,613	2,535	952	60	9	9,286	829,813	11.19
43	89	228	1,270	1,625	1,162	1,641	2,531	961	60	7	9,564	820,527	11.66
44	109	244	1,347	1,755	1,207	1,668	2,521	964	40	4	9,859	810,963	12.16
45	130	258	1,442	1,903	1,263	1,692	2,506	964	40	2	1,0190	801,104	12.72
46	157	275	1,567	2,070	1,308	1,714	2,484	959	40	1	1,0575	790,914	13.37
47	185	290	1,695	2,260	1,355	1,735	2,456	951	20		1,0947	780,334	14.03
48	215	307	1,844	2,470	1,410	1,753	2,423	939	20		1,1381	769,392	14.79
49	243	323	2,018	2,703	1,456	1,769	2,387	923			1,1822	758,011	15.60
50	276	343	2,249	2,958	1,512	1,783	2,346	904			1,2371	746,189	16.58
51	307	364	2,482	3,193	1,555	1,795	2,301	885			1,2882	733,818	17.55
52	335	385	2,743	3,486	1,608	1,803	2,244	860			1,3464	720,936	18.68
53	365	413	3,075	3,799	1,650	1,810	2,190	833			1,4135	707,472	19.98
54	391	440	3,395	4,128	1,699	1,813	2,134	808			1,4808	693,337	21.36
55	412	476	3,743	4,465	1,738	1,814	2,076	778			1,5502	678,529	22.85
56	433	512	4,116	4,792	1,782	1,811	2,014	746			1,6206	663,027	24.44
57	451	560	4,565	5,155	1,815	1,806	1,949	711			1,7012	646,821	26.30
58	468	607	4,973	5,450	1,853	1,798	1,882	685			1,7716	629,809	28.13
59	488	667	5,389	5,783	1,877	1,787	1,813	650			1,8454	612,093	30.15

TABLE I (*continued*).

REGRADUATED LIFE TABLE FOR MALES IN THE ORIGINAL REGISTRATION STATES: 1910, SHOWING COMPOUND FREQUENCY CURVE OF NUMBER OF DEATHS BY VARIOUS AGES AND ITS 10 COMPONENT CURVES OF NUMBER OF DEATHS BY AGE AND TYPICAL CAUSES.

Age.	K.	J.	I.	H.	G.	F.	E.	D.	C.	B.	A, d_x.	l_x.	$1{,}000q_x$.
60	513	726	5,866	6,100	1,900	1,773	1,742	616			19,236	593,639	32.40
61	543	800	6,276	6,395	1,923	1,755	1,657	587			19,936	574,403	34.71
62	587	883	6,674	6,664	1,937	1,730	1,582	553			20,610	554,467	37.17
63	649	956	7,047	6,889	1,947	1,706	1,507	519			21,220	533,857	39.75
64	725	1,046	7,438	7,076	1,952	1,679	1,431	490			21,837	512,637	42.60
65	832	1,128	7,740	7,227	1,949	1,648	1,354	457			22,335	490,800	45.51
66	969	1,222	7,999	7,328	1,942	1,614	1,277	425			22,776	468,465	48.62
67	1,120	1,305	8,210	7,386	1,927	1,577	1,200	394			23,119	445,689	51.87
68	1,318	1,397	8,358	7,394	1,908	1,537	1,123	368			23,403	422,570	55.38
69	1,546	1,474	8,442	7,346	1,879	1,494	1,035	339			23,553	399,167	59.01
70	1,739	1,556	8,457	7,248	1,850	1,448	962	311			23,571	375,614	62.75
71	2,049	1,625	8,400	7,099	1,808	1,390	889	288			23,548	352,043	66.89
72	2,338	1,683	8,280	6,934	1,768	1,340	819	262			23,424	328,495	71.31
73	2,630	1,730	8,102	6,682	1,713	1,287	750	238			23,132	305,071	75.82
74	2,885	1,765	7,869	6,422	1,664	1,233	685	218			22,741	281,939	80.66
75	3,154	1,787	7,539	6,114	1,609	1,177	622	196			22,198	259,198	85.64
76	3,385	1,792	7,202	5,776	1,540	1,120	562	176			21,553	237,000	90.94
77	3,576	1,783	6,825	5,412	1,479	1,062	507	160			20,804	215,447	96.56
78	3,724	1,760	6,362	5,034	1,404	1,004	444	142			19,874	194,643	102.10
79	3,820	1,720	5,929	4,700	1,337	946	396	125			18,973	174,769	108.56
80	3,852	1,670	5,482	4,310	1,256	887	350	111			17,918	155,796	115.01
81	3,829	1,602	5,029	3,916	1,188	819	309	98			16,790	137,878	121.77
82	3,744	1,530	4,512	3,531	1,104	762	270	86			15,539	121,088	128.33
83	3,614	1,440	4,064	3,156	1,035	706	235	74			14,324	105,549	135.71
84	3,423	1,340	3,632	2,795	952	652	203	66			13,063	91,225	143.20
85	3,186	1,248	3,216	2,454	884	600	174	57			11,819	78,162	151.21
86	2,944	1,138	2,772	2,178	804	548	148	48			10,680	66,343	159.47
87	2,654	1,040	2,410	1,880	740	500	122	42			9,388	55,763	168.36
88	2,347	928	2,074	1,605	664	453	102	36			8,209	46,374	177.01
89	2,071	831	1,730	1,353	605	409	85	30			7,114	38,166	186.40
90	1,770	725	1,458	1,128	547	367	70	25			6,090	31,052	196.12
91	1,482	636	1,218	931	482	320	58	21			6,148	24,962	206.23
92	1,272	540	1,005	757	430	283	46	18			4,341	19,814	219.59
93	1,002	462	797	624	374	249	37	15			3,560	15,463	230.23
94	790	380	643	493	329	218	29	12			2,894	11,903	243.13
95	623	316	512	383	279	188	22	10			2,333	9,009	258.96
96	464	250	390	288	242	162	16	8			1,825	6,676	273.37
97	342	193	299	210	201	138	10	7			1,400	4,851	288.60
98	240	150	229	149	170	116	9	5			1,068	3,451	309.48
99	171	108	170	99	132	97	6	4			787	2,383	330.26
100	109	78	120	65	113	80	4	4			573	1,596	359.02
101	67	49	87	35	87	62	1				388	1,023	379.28
102	40	28	72	12	68	49	1				270	635	425.20
103	24	10	41		49	37					161	365	441.10
104	7		26		34	27					94	204	217.02
105			18		21	19					58	110	527.27
106			13		11	12					36	52	692.31
107			7		3	6					16	16	1,000.00

TABLE II

MORTALITY TABLE FOR AMERICAN LOCOMOTIVE ENGINEERS.

Constructed by means of compound frequency curve method from records of deaths by cause and age of the Locomotive Engineer's Mutual Life and Accident Association (1907–1916).

Age.	$K.$	$J.$	$I.$	$H.$	$G.$	$F.$	$E.$	$D.$	$C.$	$B.$	$A=d_x.$	$l_x.$	$1000q_x.$
10			9	58	78	114	83	88	960	183	1,573	1,000,000	1.57
11			17	71	89	128	99	123	1,665	205	2,397	998,427	2.40
12			24	86	99	146	117	159	2,298	243	3,172	996,030	3.18
13			32	100	110	163	136	207	2,776	274	3,798	992,858	3.83
14			39	120	124	180	157	263	3,249	305	4,437	989,060	4.49
15			46	137	137	198	184	323	3,568	331	4,924	984,623	5.00
16			58	160	154	214	209	394	3,882	348	5,419	979,699	5.53
17			70	188	170	237	235	482	4,121	367	5,870	974,280	6.02
18			84	215	189	258	263	561	4,281	385	6,236	968,410	6.44
19		8	99	249	207	279	292	669	4,360	377	6,540	962,174	6.80
20		11	118	280	229	302	322	784	4,440	354	6,840	955,634	7.16
1		14	139	322	248	325	353	912	4,281	335	6,929	948,794	7.30
2		16	161	359	273	354	385	1,023	4,121	306	6,998	941,865	7.43
3		21	186	393	295	377	417	1,175	3,883	275	7,022	934,867	7.51
4		26	213	442	323	402	450	1,330	3,613	246	7,045	927,845	7.59
5		32	245	492	346	426	488	1,469	3,359	216	7,073	920,800	7.68
6		38	277	540	377	452	520	1,637	3,090	187	7,118	913,727	7.79
7		45	311	592	403	476	552	1,812	2,855	160	7,206	906,609	7.95
8		55	352	644	431	501	582	1,991	2,616	135	7,307	899,403	8.12
9		63	386	689	464	526	611	2,146	2,378	112	7,375	892,096	8.27
30		76	426	742	492	550	640	2,329	2,059	93	7,407	884,721	8.37
1		89	465	799	529	574	666	2,509	1,824	76	7,531	877,314	8.58
2		100	509	854	559	602	691	2,660	1,585	62	7,622	869,783	8.76
3		117	549	912	597	625	713	2,831	1,345	50	7,739	862,161	8.98
4		132	589	972	629	647	738	2,994	1,191	42	7,934	854,422	9.29
5	6	150	633	1,032	669	669	755	3,122	1,031	34	8,101	846,488	9.57
6	14	168	672	1,085	703	689	771	3,269	872	26	8,269	838,387	9.86
7	20	188	711	1,150	745	709	784	3,397	713	21	8,438	830,118	10.16
8	27	207	750	1,222	780	728	795	3,496	554	15	8,574	821,680	10.43
9	35	228	797	1,298	824	747	803	3,600	474	12	8,818	813,106	10.84
40	44	251	838	1,380	861	764	809	3,683	398	8	9,036	804,288	11.23
1	57	271	883	1,477	895	780	812	3,743	318	6	9,242	795,252	11.62
2	72	293	939	1,585	944	799	814	3,791	239	5	9,481	786,010	12.06
3	89	313	995	1,687	982	813	813	3,827	239	3	9,761	776,529	12.57
4	109	335	1,055	1,822	1,029	826	809	3,839	159	2	9,985	766,768	13.02
5	130	354	1,130	1,975	1,068	838	805	3,839	159	1	10,299	756,783	13.61
6	156	378	1,228	2,149	1,115	849	798	3,819	159		10,651	746,484	14.27
7	184	398	1,328	2,346	1,155	859	789	3,787	80		10,926	735,833	14.85
8	214	422	1,445	2,564	1,202	868	778	3,739	80		11,312	724,907	15.60
9	242	444	1,581	2,806	1,242	876	766	3,675			11,632	713,595	16.30
50	275	471	1,762	3,071	1,289	883	753	3,600			12,104	701,963	17.24
1	306	500	1,945	3,315	1,326	889	739	3,524			12,544	689,859	18.18
2	334	529	2,149	3,619	1,371	893	721	3,425			13,041	677,315	19.25
3	364	568	2,409	3,943	1,407	896	703	3,317			13,607	664,274	20.48
4	390	605	2,660	4,285	1,449	898	685	3,218			14,190	650,667	21.81
5	410	654	2,933	4,635	1,482	899	667	3,098			14,778	636,477	23.22
6	431	703	3,225	4,974	1,519	897	647	2,971			15,367	621,699	24.72
7	449	769	3,577	5,351	1,548	895	626	2,831			16,046	606,332	26.46
8	466	834	3,897	5,657	1,580	891	604	2,728			16,657	590,286	28.22
9	486	916	4,223	6,003	1,600	885	582	2,588			17,283	573,629	30.13
60	511	997	4,597	6,332	1,620	878	559	2,453			17,947	556,346	32.26
1	541	1,099	4,918	6,638	1,640	869	532	2,337			18,574	538,399	34.50
2	585	1,213	5,229	6,917	1,652	857	508	2,202			19,163	519,825	3.668

Age.	K.	J.	I.	H.	G.	F.	E.	D.	C.	B.	$A=d_x$.	l_x.	$1000q_x$.
63	647	1,314	5,522	7,151	1,660	845	484	2,067			19,690	500,662	39.33
4	722	1,437	5,829	7,345	1,664	832	459	1,951			20,239	480,972	42.08
5	829	1,550	6,065	7,502	1,662	816	435	1,820			20,679	460,733	44.88
6	965	1,679	6,268	7,607	1,656	799	410	1,692			21,076	440,054	47.89
7	1,116	1,793	6,434	7,667	1,643	781	385	1,569			21,388	418,978	51.05
8	1,313	1,919	6,550	7,675	1,627	761	361	1,465			21,671	397,590	54.51
9	1,540	2,025	6,615	7,625	1,602	740	332	1,350			21,829	375,919	58.07
70	1,732	2,138	6,627	7,524	1,577	717	309	1,238			21,862	354,090	61.74
1	2,041	2,233	6,583	7,369	1,542	689	285	1,147			21,889	332,228	65.89
2	2,329	2,312	6,489	71,98	1,508	664	263	1,043			21,806	310,339	70.27
3	2,620	2,377	6,349	6,936	1,461	638	241	948			21,570	288,533	74.76
4	2,874	2,425	6,167	6,666	1,419	611	220	868			21,250	266,963	79.60
5	3,142	2,455	5,908	6,347	1,372	583	200	780			20,787	245,713	84.59
6	3,372	2,462	5,644	5,996	1,313	555	180	701			20,223	224,926	89.91
7	3,563	2,450	5,349	5,618	1,261	526	163	637			19,567	204,703	95.59
8	3,710	2,418	4,986	5,225	1,197	497	143	565			18,741	185,136	101.23
9	3,806	2,363	4,646	4,879	1,140	469	127	498			17,928	166,395	107.74
80	3,838	2,294	4,296	4,474	1,071	439	112	442			16,966	148,467	116.42
1	3,815	2,201	3,941	4,065	1,013	406	99	390			15,930	131,501	121.14
2	3,730	2,102	3,535	3,665	941	378	87	342			14,780	115,571	127.89
3	3,601	1,979	3,184	3,276	883	350	75	295			13,643	100,791	135.36
4	3,410	1,841	2,846	2,901	812	323	65	263			12,461	87,148	142.99
5	3,174	1,715	2,520	2,547	754	297	56	227			11,290	74,687	151.17
6	2,933	1,564	2,172	2,261	686	272	48	191			10,127	63,397	159.74
7	2,644	1,429	1,888	1,952	631	248	39	167			8,998	53,270	168.91
8	2,338	1,275	1,625	1,666	566	224	33	143			7,870	44,272	177.76
9	2,063	1,142	1,356	1,404	516	203	27	119			6,830	36,402	187.63
90	1,763	996	1,142	1,171	466	182	22	100			5,842	29,572	197.55
1	1,476	874	954	966	411	159	19	84			4,943	23,730	208.30
2	1,267	742	788	786	367	140	15	72			4,177	18,787	222.33
3	998	635	624	648	319	123	12	60			3,419	14,610	234.02
4	787	522	504	512	281	108	9	48			2,771	11,191	247.61
5	621	434	401	398	238	94	7	40			2,233	8,420	265.20
6	467	344	307	299	206	80	5	32			1,740	6,187	281.23
7	341	265	234	218	171	68	3	28			1,328	4,447	298.63
8	239	206	179	155	145	58	3	20			1,005	3,119	322.22
9	170	148	133	103	113	48	4	16			735	2,114	347.68
100	109	107	94	67	96	40		13			526	1,379	381.43
1	67	67	68	36	74	31		4			347	853	406.80
2	40	39	56	12	58	24					229	506	452.57
3	24	14	32		42	18					130	277	469.31
4	7		20		29	13					69	147	469.39
5			14		18	10					42	78	538.46
6			10		9	6					25	36	669.44
7			5		3	3					11	11	1,000.00

MANUFACTURERS' AND CONTRACTORS' PUBLIC LIABILITY INSURANCE.

BY

G. F. MICHELBACHER.

It has been my observation that the student who desires to secure membership in our Society, and who must, therefore, prepare himself for examination in the various forms of casualty insurance is handicapped by the lack of papers dealing with these subjects. I have thought that the preparation of such papers according to a prearranged formula and their publication in our *Proceedings* would be highly desirable. We have had no papers, for example, on automobile insurance, public liability insurance, personal accident and health insurance, and some of the other important forms of casualty insurance in which we examine prospective members.

The following discussion of manufacturers' and contractors' public liability insurance, while it is by no means a model paper, will, it is hoped, stimulate interest in the preparation of similar papers on such forms of casualty insurance as have not as yet received recognition in our publications.

POLICY COVERAGE.

The public liability policy insures against loss or expense incurred by reason of liability imposed by law for damages on account of bodily injuries, including death, accidentally suffered by the public. It does not contemplate the payment of damages to injured workmen, but deals exclusively with injuries to persons not employed by the assured; hence, the term public liability as distinguished from employers' liability or workmen's compensation. It does not contemplate payments for personal injuries to the assured, but does apply to injuries done to the persons of others, not his employees; hence, the distinction between personal accident insurance and public liability insurance. It should be further noted that property damage is not covered, but that the coverage is limited exclusively to bodily injuries.

Because of the complex nature of the public liability risk, it has

been necessary to create a variety of policy forms to provide coverage. By way of defining the scope of this paper, it might be well briefly to mention the forms of policies used in connection with this insurance and to point out the forms which will be discussed.

The various forms of policies may be classified first, according to the degree of liability assumed by the insurance carrier. This will result in two principal groups: one, containing those forms which provide insurance coverage for persons primarily liable for damages to the injured public, and a second, in which may be placed those forms providing coverage for persons who, by reason of their connection with an enterprise, may be contingently liable. A second classification will then distribute the various policy forms to these groups according to the nature of the business operations conducted by the assured, the premises which he controls or his interest in the enterprise under consideration.

Using this method, we may classify public liability policies as follows:

Group I:

(*a*) Manufacturers. Issued to manufacturers of every description.

(*b*) Contractors. Issued to general contractors, building contractors, telegraph and telephone companies, electric light and power and mining companies and to persons conducting operations not confined to manufacturing premises.

(*c*) Owners, landlords or tenants. Issued to owners, landlords or tenants of premises (not manufacturers). This form is used for hotel, tenement and mercantile risks and risks of similar character.

(*d*) Teams. Issued to those who operate draught animals, with or without vehicles.

(*e*) Automobile. Issued to those who operate automobiles.

(*f*) Elevators. Issued to those who maintain and operate elevators used for conveying passengers or freight, or both passengers and freight.

(*g*) Theater. Issued to owners, lessees or tenants of theaters, public halls and other places of amusement.

Group II:

(*a*) Contractors' Protective. Issued to contractors to provide protection for the contingent liability arising out

of claims for damages for injuries caused by a subcontractor or his employees.

(*b*) Owners' Protective. Issued to owners of buildings in the course of construction to provide for the contingent liability arising out of claims for damages for injuries caused either by the contractor, subcontractor or their employees.

(*c*) Landlords' Protective. Issued to the owner or general lessee of a building, who has leased the entire premises to another and retains no control over them, to provide protection for the contingent liability arising out of the maintenance, use and operation of the building.

Premium Bases.

For the sake of convenience in selling and underwriting this kind of insurance the premium bases, used in connection with the policy forms, vary considerably.

In general, it may be stated that the payroll basis is used in connection with manufacturers' and contractors' policies. That is to say, rates are quoted for each one hundred dollars of payroll as in the case of compensation or employers' liability insurance. As a matter of fact, these forms of coverage are usually written concurrently with compensation or employers' liability policies, and prior to the introduction of compensation, it was frequently the practice, in some instances, to cover the liability to employees and to the public in a single policy. One estimate of payroll by classifications serves the purpose of providing a basis for the calculation of the premium for both forms of coverage as each manual classification carries with it a rate for public liability as well as a rate for compensation or employers' liability, as the case may be. The general rule is subject to exceptions, however, in special cases where, for some reason or other, the payroll expenditure does not provide a satisfactory basis for premium computation. Thus, rates are quoted per one hundred square feet of surface for the operation and maintenance of advertising signs, per machine for the operation of automatic, slot or vending machines, and per day in the case of hod hoist installation, operation and removal. It is a universal rule that separate policies must be issued to cover the liability arising out of the maintenance, use and operation of teams or automobiles.

The premium basis in the case of the owners', landlords' and tenants' policy is in general the so-called "area and frontage" basis. That is to say, the rates are based upon each lineal foot of street frontage and each one hundred square feet of area. However, as in the case of manufacturers' and contractors' policies, this general rule is subject to exceptions whenever, for any reason, the area and frontage basis is impracticable. Thus, cemetery companies are written on the frontage basis exclusively. Dance halls and amusement halls of various descriptions, with the exception of theaters, are written on the gross receipt basis; that is, rates are quoted per one hundred dollars of gate or admission receipts. Churches are written at a flat charge per church, which varies with the population of the city in which the church is located. In connection with this form of coverage, it is the universal rule that elevators, if there are any, must be either specially rated in accordance with the rules governing elevator coverage or specifically excluded from the policy.

In the cases of teams, automobile and elevator policies, the premium basis is the individual team, automobile or elevator. Rates are quoted per team, per automobile or per elevator. Here again there are exceptions which are not of great importance; as, for example, the payroll basis or the named chauffeur basis in certain forms of automobile insurance.

Theater liability policies are issued to owners of theaters and motion picture halls. The premium basis is the seating capacity of the house. The unit is one seat, and rates are quoted per seat per annum.

So much for the policies classified under Group I.

In the cases of owners' and contractors' protective policies, the premium basis is "the total cost of all work, let or sublet, including all labor, material and equipment used or delivered for use in the execution of such work, whether furnished by the owner, the contractor or the subcontractor, also all allowances, bonuses or commissions made, paid or due." Thus the premium for owners' protective insurance, where the owner furnishes no material, tools or equipment, is based upon each one hundred dollars of the total cost of the work, let or sublet.

Landlords' protective policies correspond to both owners', landlords' and tenants' and elevator policies. The bases for rates are the same as the bases used for these allied forms, the rates being obtained by the use of a percentage differential.

The particular forms of policies which will be discussed in this paper are the manufacturers' and contractors' forms, which provide public liability coverage for manufacturers and contractors and which, in general, are written on the payroll basis.

HAZARDS.

Public liability hazards are more or less unique. They are not similar to the hazards of employers' liability or workmen's compensation insurance. It must be recognized that the probability of the occurrence of accidents will vary with the person exposed. In the case of employers' liability or workmen's compensation it is the assured's employee who may be injured; and in public liability it is a person who is not employed by the assured. The majority of manufacturing risks may be similarly rated for public liability coverage, although there are a great number of variations in the rates for either employers' liability or compensation coverage.

So far as the writer knows, no one has ever attempted to set down and classify public liability hazards. This would, indeed, be a task and, moreover, it seems certain that no comprehensive classification could be devised which would stand the test of providing a place for the numerous hazards which present themselves for consideration. As in compensation and liability insurance in general, the hazards of individual classifications must often be considered by themselves.

A knowledge of the hazards to be insured is, of course, absolutely indispensable and the following statement of some of the more striking public liability hazards has been attempted with a view to defining the subject in a general way. It should be remembered that the exposure is to the public and not to the employees of the assured, and that the hazards are those incidental to manufacturers' and contractors' public liability insurance.

With this in mind, it follows that the hazards are for the most part physical and largely independent of such factors as determine the operative procedure within the walls of plants. For example, it goes without saying that most public liability accidents are caused by persons coming in contact with property of the assured, or with physical conditions legally under his care or control and that there are no such hazards as the stamping press, emery wheel and set-screw hazards so much discussed in connection with employers' liability and compensation insurance.

An important public liability hazard may be designated as the *Street Hazard.* This hazard is found in connection with street work of all kinds, as for example, the laying of mains, paving, street and road making. It is also found in connection with work involving the use of streets, roads or highways, as in the case of live stock driving and in connection with work involving the exposure of persons passing through the streets, as, for example, construction work of many kinds on property adjacent to streets, electric light, telephone and telegraph work, involving the use of transmission wires, the construction and repair of bridges, the pruning, spraying, trimming and fumigating of shade trees, etc.

Closely allied to this hazard is the *Sidewalk Hazard,* which is somewhat similar in that the operations which produce it are in general the same as those which produce the Street Hazard, though limited in their effect to the area of the sidewalk. Thus, there are the classifications involving the construction, relaying and repair of sidewalks, the installation and repair of light prisms, window panes, awnings and signs, the painting of store fronts, bill posting and the general hazard of building operations on property fronting on and contiguous to walks used by the public. In addition to these, there is a distinct hazard in connection with the loading, unloading and piling of material. Safe moving, rigging, the installation of boilers, engines and machinery, with the incidental work of taking the material from the truck in the street into the building in which it is to be installed, expose the public on the sidewalk as do other unloading operations where for some reason or other it is necessary to pile lumber, bricks or other material on or near sidewalks. Partly because of the existence of this hazard, partly for other reasons, a special rate is provided for blacksmiths who lead or drive animals owned by customers to and from their shops.

The *Open Pit* or *Excavation Hazard* may next be mentioned. It is found as a sub-hazard under the headings "Street Hazard" and "Sidewalk Hazard" wherever for any reason it is necessary to dig trenches, pits or other excavations, but it is also found as a separate and distinct hazard in the case of excavating operations which are performed neither in the streets nor sidewalks. It is found, for example, in connection with tunnel and cesspool excavating, excavating for bridge foundations, retaining walls and bases of dams, and in quarrying, mining and clay digging. The par-

ticular risk here is the danger of persons falling into an unprotected opening. The degree of hazard varies directly with the exposure to public traffic and the area and depth of the excavation.

A fourth important hazard is the *Yard Hazard.* The yard, as distinguished from the buildings or other enclosed and roofed portions of a manufacturing plant, usually presents some exposure to the public. In some cases the yard may be well guarded by a substantial wall and by watchmen; in other cases a fence of some sort or other may mark the boundary lines, and there are still other cases where nothing but the piled material indicates the confines of the yard. Consequently there are many degrees of yard hazard in connection with the manufacturing classifications. Then there are classifications which may be said to contemplate a yard risk exclusively; as, for example, asphalt works, brick manufacturing, concrete block manufacturing, etc. In the case of manufacturing risks, the nature of the raw and finished products has much to do with the size of the yard used for storing and piling material. Thus, a large yard may be expected in connection with the operations contemplated by certain woodworking and metalworking classifications. Then there are hazards to which a person who has gained access to the yard may be exposed; as, for example, steam discharge pipes, uncovered vats, oily gutters, carelessly piled material, etc. Railroad connection with a plant, the extent of railway and switching facilities, the operation of cars in the yard and other transportation factors are also important.

Another hazard which it is difficult to name may be designated by the term *Salesroom Hazard,* a term which does not exactly describe it. This hazard is found wherever messengers, collectors, prospective purchasers, delivery men or the general public have access to a portion of the assured's premises or plant. The hazard is present in clothing manufacturing risks, film exchange risks, fruit packing risks and risks of similar character.

The *Warehouse Hazard* may be mentioned as closely analogous to the salesroom hazard. The hazard here is much the same and is due to the fact that persons other than employees of the assured deliver and take away merchandise of one sort or another. All warehousing risks present this hazard as well as similar classifications, such as express companies, forwarding agents, etc.

While the last two hazards apply strictly to persons who do not remain on the premises or near the working place any long period

of time, there is a hazard which may be called the *Fellow Worker Hazard.* This hazard arises by reason of the fact that employees of the assured often work with or in close proximity to the employees of other persons. This hazard is found particularly in connection with contracting operations where the employees of several individual contractors may be engaged in construction work at the same time. Masons, iron workers, marble and stone workers, tile workers, painters, gas, steam and hot water fitters, elevator constructors and carpenters—each trade under the supervision of a separate contractor—may all be at work at one time in a modern skyscraper. Then there are the cases of tallymen, factory cost systematizers, millwrights, boiler scalers, elevator repairmen, supervising architects, etc., each of which presents a similar hazard in some degree.

The use of explosives, corrosives and other dangerous substances gives rise to another hazard which may be termed the *Dangerous Substance Hazard.* The explosion hazard is found in connection with contracting classifications wherever explosives are used for blasting, for removing tree stumps and similar operations; also, in manufacturing classifications, as, for example, in the manufacture of celluloid, powder, fuses, starch and glucose. The general hazard of dangerous substances to which the public is exposed is found in the use of acids, hot liquids and molten metal, in manufacturing plants and elsewhere. Though not exactly comparable with other hazards classed under this heading, the fact may be mentioned that separate public liability rates are provided for the inclusion and exclusion of the gas explosion, inhalation and asphyxiation hazards in connection with the operation of gas works.

In addition to these hazards, there is a miscellaneous class into which all the remaining physical hazards may be thrown. The *Collision Hazard* found in connection with the operation of barges, lighters, and other vessels would be thrown into this class, as would the hazard arising from salesmen, messengers and collectors who do not use vehicles, as, for example, the hazard arising from the transportation of merchandise through the streets by messengers.

The *Catastrophe Hazard* in public liability insurance is found largely in connection with contracting, transportation and amusement-hall risks, although there is a possibility of serious accidents in connection with the operations incidental to certain manufacturing classifications. In this discussion, we are not interested in

transportation and amusement-hall risks, but is should be pointed out that a sufficient catastrophe hazard remains which requires our attention. There are, for example, such hazards as the collapse of buildings in the course of construction, serious explosions and others which should be noted.

In the moral-hazard column, the hazards are as intangible as moral hazards usually are, but it may be said that there are not so many of them, nor do they play the important rôle they play in connection with other forms of insurance. The moral hazard of fraud and deception on the part of the assured is not important, but in its place there is substituted a similar hazard on the part of claimants. Then there are the usual hazards of carelessness, negligence, mismanagement or poor management and the hazards incidental to the legal procedure found in damage insurance of all kinds. But these hazards, as stated above, are intangible; they cannot be weighed and measured for the individual classification. Their effect, if any, is reflected in the experience and enters into the rates in this manner. There is no particular loading which can be pointed to as a moral-hazard loading as in the case of compensation insurance, where a rate may be discounted by the application of a merit-rating plan.

History of Rate-Making.

In the beginning rates for manufacturers' and contractors' public liability insurance were judgment rates; that is to say, they depended largely upon the personal opinion of underwriters as to what the public-liability hazard in connection with each classification was worth.

If the records of the National Workmen's Compensation Service Bureau are to be trusted as representative, there was no great volume of experience available for this class of insurance until some time in the 1900's. One compilation of experience shows that the total payroll exposure in 1889 for all classifications was less than $500,000 and that this volume, while it increased rapidly, did not exceed $350,000,000 by 1900. It follows, therefore, that the judgment method of rate determination was followed until a comparatively recent date.

There does not seem to have been any formula by which the early rates were derived, except that rates for the manufacturing clas-

sifications evidently bore some rough relationship to the corresponding employers' liability rates. It is evident that some method was followed of grouping manufacturing classifications by employers' liability rates and then determining the public liability rate for each group by a judgment of the relative hazards of the two forms of coverage. There seems to have been a more careful use of judgment in the establishment of rates for the contracting classifications, but without the aid of experience, it is certain that this judgment was in some measure influenced by the corresponding employers' liability rates.

Three extensive compilations of experience by classifications have been made by the Bureau. The first of these covered policy years 1889 to 1900 and was brought down to January 1, 1903; the second, policy years 1889 to 1903, brought down to December 31, 1906, and the last and most recent, policy years 1908 to 1912, brought down to June 30, 1914. With the accumulation of experience to aid judgment, the establishment of rates has become more and more a matter of the scientific application of underwriting judgment. This is distinctly shown by the fact that the additional experience available for the recent revision of rates corroborated in general the rates for contracting classifications, although it did point out many discrepancies in the manufacturers' classifications, a result to be expected, for reasons to be stated later.

The latest revision of rates for Manufacturers' and Contractors' Public Liability Insurance was undertaken in 1915. The experience then available produced a payroll exposure for all classifications of approximately $2,290,000,000.

Difficulties in Rate-Making.

The great volume of public liability experience did not eliminate certain difficulties which are incident to a discussion of public-liability rates. In the first place, it should be noted that approximately half the volume of this experience is concentrated in classifications rated $.05 and under. Thus, it happens that large exposures for individual manufacturing classifications fail to produce losses and afford no guide to the underwriters' judgment. This is true because of the low degree of hazard presented by these classifications. It often happens that a low-rated risk will continue to produce no losses for years and will then produce an accident

which will cost from $50 to $5,000. The law of averages is working as surely as it works, for example, in connection with compensation insurance, but it requires a considerable period of time for its results to be ascertained and its law determined and in this period of years the exposure increases until a considerable volume has been accumulated.

An exposure of $100,000,000 should be available for the majority of manufacturing classifications before the experience for the individual classification can be considered at all dependable, and it is likely that a great part of this exposure will be accumulated without losses. This fact makes it necessary for the underwriter to resort to the grouping method of determining rates. Thereby the use of judgment is limited to a discussion of the analogy of hazard between classifications, and the experience for the group, when completed, serves as a basis for the rates for all classifications in the group.

With no experience indication for the individual classification, the underwriter, in forming his group, may overlook certain inconsistencies which become evident as soon as additional experience has been accumulated. It, therefore, happens that, with the accumulation of experience, the make-up of the groups is considerably changed. For example, at the time of the revision of rates, preceding the last, it was evidently decided that no metal-working risks should be placed in the two lowest rated groups. This decision was based upon judgment. The accumulated experience which the underwriters had to assist them in the last revision of rates indicated that this decision was not justified and a redistribution of the metal-working classifications was accordingly made.

This, then, is the first difficulty: The fact that large exposures for individual classifications produce no losses causes underwriters to rely entirely upon their own judgment in certain cases, this exercise of judgment being limited to a determination of the analogy of hazard and resulting in the formation of groups of analogous classifications. With a large number of classifications to handle, this method, no matter how carefully followed, must necessarily produce some inconsistencies. The number of these inconsistencies will vary, of course, with the volume of experience for individual classifications and some day will disappear entirely by the process of constant correction and closer approximation to the truth.

A second difficulty, which will also disappear in time, has to do

with the fact that there has not always been a uniform manual of public liability classifications. This fact seriously interferes with the use of old experience in the determination of rates for the present classifications. Practically simultaneously with the introduction of workmen's compensation laws came the Basic Manual with its uniform series of classifications for compensation and public liability insurance. This fact and the further fact that compensation insurance matures with some degree of rapidity has enabled casualty companies to accumulate a considerable volume of compensation experience for classifications which always have been worded in substantially the same manner. To be sure, public-liability insurance was placed on this same basis, but, whereas compensation was an entirely new line, public liability was an old line and the change in classifications has made it difficult to combine the new experience for many classifications with the old experience for classifications which, while they may express practically the same hazard, differ in some particulars, so that the combined experience would not give a true indication. This does not necessarily mean that all the old experience must be discarded. It is still possible to use it as a guide. For example, it is possible to use the experience for classifications "Machine Shop—with or without foundry" and "Machine Shop—including outside work" as a guide in the discussion of rates for classifications "Machine Shop —with foundry" and "Machine Shop—without foundry" but it is impossible to combine this experience with the experience for either of the present classifications. We, therefore, have been forced to throw overboard a lot of valuable information and to start our accumulation of experience all over again with the classifications in the new manual as a basis. This may be inconvenient at present, but the advantage of having a uniform series of classifications far outweighs this temporary inconvenience and we are certain to accumulate a more dependable volume of experience in a comparatively short period of time under this plan.

The third difficulty which may or may not be of vital importance arises from the fact that conditions may change so radically while the experience is maturing that the experience available for a revision of the manual may not be adequate to meet new conditions. Liability claims are slow to mature. There is a considerable delay in the settlement of cases. It has been stated that "the average time required to effect a settlement through legal procedure is

about five years" in California and there does not seem to be any reason why cases of this character should require a longer period of time for their adjudication in California than elsewhere. During this period which must elapse before the experience can be considered dependable, there will be some tendency toward reforms in process, methods of conducting operations, etc., which must not be overlooked.

RATES.

There are two series of rates for this class of coverage: one for all states, excluding certain large cities; the other for the large cities excluded from the first territory.

The interpretation of laws relating to damages for bodily injuries, the attitude of juries and the general moral hazard do not differ enough to require the use of differentials for states or groups of states, as in the case of workmen's compensation insurance.

The reason for a differential in the case of large cities is found in two hazards which have been explained, viz., the street and sidewalk hazards. In connection with classifications presenting a considerable degree of exposure to either of these hazards, a differential as between cities and other territory can be justified both by experience and by general reasoning. For example, general reasoning would lead to the statement that these hazards vary directly with traffic density, which in turn varies with population density, width of streets, traffic regulations and similar factors. From this statement, it is merely a step to the assertion that these hazards vary directly with population density and consequently with the population of towns and cities. The experience then helps to determine the degree to which these hazards vary with population density. No differentials have been applied where experience either for the individual classification or for the group of analogous classifications does not justify this method of treatment. It goes without saying that the classifications where differential rates have been established are almost exclusively contracting classifications.

The formula by which rates are determined is a simple one, viz.,

$$\text{Rate} = 2 \times \text{Pure Premium.}$$

There never has been an attempt made to analyze this formula as the formula for compensation rates has been analyzed. It is used in all lines of public liability insurance and, from all appearances, has given complete satisfaction.

The number of rate grades or differences in hazard in this form of insurance is 26 as compared with 115 in the case of compensation insurance. In other words, there are 26 possible hazard groups. In degree of hazard, the manufacturing classifications come first, so that the seven lowest rated groups contain nothing but manufacturing classifications, the majority of which are concentrated here, although others are distributed throughout the entire series. This concentration of manufacturing classifications in seven of the twenty-six groups accounts for the fact that the greater proportion of payroll is found in the lower rated groups. The contracting classifications, in a large measure, fill up the remaining groups. The variation in rates for the groups composed strictly of manufacturing classifications is from $.02 to $.20, whereas the variation in rates for the remaining groups is from $.25 to $12.50.

The method of rating has been fairly well described. The exposure is payroll. The classifications, particularly the manufacturing classifications, are grouped according to analogy of hazard and in this process the experience for individual classifications is used to supplement underwriting judgment. Then, the rate for all classifications in the group is determined with reference to the indicated pure premium for the group. Much the same procedure is followed in the case of contracting classifications, although there are several groups containing but one or two classifications in which experience and judgment are applied to the individual classification. In this way, one series of rates is determined which applies to the country as a whole. Wherever a differential rate is necessary, the experience furnishes the basis for the determination of this differential, although the grouping or analogy method is used to some extent in this connection as well as in the determination of rates for the country at large. That is to say, there may be a considerable volume of experience for one classification which justifies a differential. For an analogous classification there is no considerable volume of experience, but the differential is extended to this classification because of the analogy of hazard.

General Trend of the Cost of this Coverage.

Some years ago there was much talk of the increasing cost of employers' liability insurance. Today we hear the same talk with reference to workmen's compensation insurance. Actuarial com-

mittees have from time to time studied these problems and it is certain that today the "increasing cost" factor in compensation insurance is a most important item to be considered in producing rates for this form of insurance. The question naturally arises in connection with other forms of insurance: Is the cost increasing or decreasing, or is it standing still? And the final rate often depends upon the answer to this question.

Public liability insurance, as before stated, was formerly considered so closely analogous to employers' liability insurance that one policy was frequently issued to cover both hazards and the rates for public liability were determined with scrupulous regard for the corresponding rates for employers' liability. This might lead one to suspect that if the opinion of underwriters of those times was borne out by the experience, there must have been a decided tendency for the public liability experience to grow worse as the cost of employers' liability increased. This does not seem to have been the case, however. The statement of public liability experience for the years 1889 to 1903, prepared by the Bureau, indicates beyond a doubt that, while the cost may have fluctuated considerably for years down to and including 1898, there was a decided downward tendency following that year. This tendency is corroborated by additional experience for the years 1908 to 1912 which indicates the following interesting results, using the pure premium for the year 1908 as a basis:

Year.	Payroll Exposure.	Cost Factor.
1908	$308,146,332	100.0
1909	400,857,471	94.5
1910	532,589,156	96.5
1911	476,226,147	98.0
1912	571,719,514	89.0
Total all years	$2,289,538,620	95.5

Thus it would seem that there was no sympathetic relationship between the cost of public liability and the cost of employers' liability. Such arguments as the arguments of increasing cost by reason of changing conditions, a general speeding up of industry, innovations of one sort and another, which might revolutionize methods of construction and manufacturing, are not supported by the experience in this line of business prior to the general introduction of compensation laws.

Today, however, there are better arguments upon which to base

a prediction that the cost of public liability will increase in the future. There are as yet no figures to prove or disprove these arguments, but they are interesting enough to warrant mention here.

These arguments have to do with the possible effect of the introduction of workmen's compensation laws. We have seen that the causes which produced an increase in the cost of employers' liability evidently did not have any effect on the cost of public liability. What is the situation today when compensation has largely replaced employers' liability? What effect, if any, can the introduction of compensation have upon the cost of public liability?

There seem to be several possible reasons why the introduction of workmen's compensation laws should affect the cost of public liability.

In the first place, many of the reactions of compensation laws upon workmen will be felt in connection with public liability insurance. There are, for example, the increasing tendency to malinger which may cause excessive and fraudulent claims to be presented, the ever-increasing tendency to claim something for each trivial injury, the growing knowledge that personal injuries may be used as a basis for claims for damages as well as compensation, etc. These same influences affect persons who are not workers; but even though this were not the case, the fact that most of the persons who are exposed to public hazards work and have become thoroughly familiar with the theory and purpose of workmen's compensation laws and incidentally with related laws bearing on the subject of personal injury, must give some weight to this argument. The greater percentage of persons who were ignorant of their legal rights under employers' liability have been educated to know their rights in the case of compensable injuries. It is to be expected that the fact that compensation may be collected for one class of injury will at least open the minds of workers to the possibility that there is some payment for every class of bodily injury suffered by reason of accident.

In the second place, the effect of workmen's compensation laws upon certain members of the legal profession indirectly has a bearing on this question. The Casualty and Surety Section of the *Insurance Field* for April 13, 1916, contained the following interesting note under the heading "Ambulance Chasing":

"Law suits against automobile drivers in accident cases, which

have been rapidly increasing in Ohio, are attributed to the operation of the workmen's compensation law in that State. The situation is accounted for in this way: Lawyers who make a specialty of accident cases formerly were so occupied with suits against railroads, street car companies and manufacturing plants that they had not time to handle cases against automobile owners, but as the state law now takes care of all accidents in industrial enterprises, there is so little opportunity for suits that a majority of lawyers have diverted their attention from industrial cases to accidents due to automobile hazard." Needless to say, this diversion of effort from the industrial accident field has not caused this class of the legal profession to limit their energies to automobile accidents. It is certain that the accident field in general, outside the forbidden territory, has become, in large measure, the stamping ground for these members of the profession and that this field is being tilled intensively for possible damage suits.

In the third place, there is the effect of the "Safety First" movement which has attended the introduction of compensation laws. The effect here may or may not largely neutralize the effect of the other factors. While this movement has been devoted largely to conditions in industry, a decided tendency has manifested itself to extend this doctrine to accidents in general. Safety sheds, safety stations, safety signs, safety lectures for children as well as for parents, safety articles concerning accidents and their prevention and the general program of making persons think and live safety must have had something to do with reducing the frequency of public accidents. We hear the cry "Watch your step." We see red flags and other signals of danger where there is probability of an accident. Dangerous places are protected or fenced off; a man stands ready to warn you away from a dangerous position, and safety devices have been installed and used wherever possible. Such terms as anti-skid, anti-slip, non-inflammable, safety this and safety that are taking on a new meaning. They are becoming catch words and that proves that the safety idea is finally reaching the people who can prevent public accidents.

But this same "Safety First" idea may cause a greater loss after the occurrence of an accident. The public at large and juries in particular cannot continue to look upon preventable accidents lightly. A preventable accident may become a crime and a reason for an excessive award and as we learn more and more about the

meaning of the word "preventable" we may find a factor of increasing cost in the legal procedure incidental to damage suits. Here again the increasing cost may or may not make itself felt. It is merely a possibility.

Just what the net effect of these factors may be we have no way of knowing. It is just possible that the present general level of cost will continue without a material tendency either upwards or downwards. It will be interesting to watch the experience for some evidence of the truth of these arguments.

Some Essentials of Sickness Statistics.*

BY

EDWIN W. KOPF.

PART 1. DESCRIPTIVE SICKNESS STATISTICS.

Papers such as Mr. Albert H. Mowbray's "Age, Occupation and Residence as Variants of the Rate of Sickness" (*Proceedings*, Vol. III, p. 213) and the numerous briefs presented to committees of American legislatures during the health insurance campaign of the winter of 1916–1917, indicate the necessity for a connected statement of the essentials of sickness statistics, their nature, limitations, uses and practical bearings. The following discussion, taken from notes prepared for a text on general social statistics, is offered as an initial study of the subject in its broad practical aspects. The refinements which ought to characterize a final reaction to the problem of sickness statistics will be left to other students who may have opportunity to carry on further inquiry.

The briefs so far available show a variety of concepts of the facts of sickness, of its causes, incidence, duration, practical social management and of its immediate and remote consequences. The opinions and impressions offered our American legislatures during the past winter have very much the same general characteristics of those which prevailed during the agitation for social reform in England under Earl Grey, Russell, Peel, Palmerston, Disraeli and Gladstone. There was a mighty conflict of opinion and a dearth of thoroughly digested facts. We have but to view the work of the seventh Earl of Shaftesbury—statistician and statesman—in England and to reflect upon the social reforms which followed in that country from his steadfast adherence to ascertainable facts, to impress us that we, in America, must insist upon an impartial, thorough search for the facts of sickness if we would build a durable insurance and public health structure. Simple dependence upon European experience and upon our primary reactions to the

* Part of a chapter from "Essentials of Social Statistics: A Manual for Students of Casualty and Social Insurance." (In preparation.)

few social facts of sickness we have, cannot serve us for any considerable period.

The facts of sickness may be determined in two ways and by two professional groups: *intensively,* through inquiry into the structure and functions of the human body in health and in disease; and *extensively,* through inquiry into sickness as a *mass phenomenon*—into its occurrence, duration, nature, causes and effects among and in groups of mankind. The medical profession is charged with the *intensive* study of sickness and of health; the social statisticians must continue their important function of studying sickness *extensively.*

The extensive method may be considered in two parts: (1) Statistical *description* of sickness, or the collection, editing and tabulation of crude data, and (2) graduation and higher *critical analysis* of tabulated data.

Historical Aspects of Sickness Statistics.

The extensive study of sickness has proceeded since 1773 in England when Francis Maseres in his "Treatise on the Doctrine of Life Annuities" (2d vol.) published his approximate sickness tables in connection with a bill for voluntary workmen's sickness and old age insurance, introduced by a Mr. Dowdeswell into the House of Commons. The sickness table and hypothesis of Price followed.* Research into sickness experience was continued in England by Oliphant (1824), Ansell (1835), Finlaison (1853 and 1854), Neison, senior (1857), Ratcliffe (three investigations, the last for the period 1866 to 1870), Neison, junior (1882 and 1900), Sutton (1896), Watson (1903) and Hardy and Wyatt (1911). These investigations were largely limited to Friendly Society experience.

In Italy, an investigation of sickness experience was published as early as 1879.†

In Germany, Karl Heym (1855) seems to have been the pioneer in statistically studying sickness. He prepared a sickness table, using the Finlaison 1846 to 1850 data as a base. Heym later published tables in 1878 and in 1884. From Heym's 1884 table

* "Observations on Reversionary Payments," VI edition, Vol. II, p. 473. London. 1803.

† "Statistica della morbosità ossia frequenza e durata delle malattie presso i soci della società di mutuo soccorso." Rome. 1879.

the memorial on old age and invalidity insurance was prepared for the Reichstag session of 1888–1889. Further tables of importance were Bleicher's (1900), for the sick benefit society of Frankfurt and Mayet's relating to the experience of the Leipzig Local Sick Benefit Society over the years 1887–1905.* The chief tables for Switzerland are those of Kinkelin (1880), based upon Heym's 1878 table, and Moser's 1884–1893 Berne Cantonal Sick Benefit Fund table.

In the United States we have available only the Billings morbidity tables of the 1880 and 1890 censuses, the records of a few fraternal societies and of some industrial establishment benefit funds, the community sickness censuses of Messrs. Frankel and Dublin; some data from casualty companies writing health business, and a few tables on acute and chronic diseases published by the Commonwealth of Massachusetts are also available.

The continuous registration of infectious or other diseases has had a rather checkered career in the United States. So far as known, the effort of the Michigan State Board of Health, beginning in 1876 under the direction of Dr. Henry Brooks Baker, was the first moderately successful attempt to make certain diseases compulsorily notifiable. There was a similar movement for sickness registration in Massachusetts in the same year under leadership of Dr. F. W. Draper. The registration of such diseases has met with modest success for many years in a number of cities like Providence, R. I., Philadelphia, Pa., Boston, Mass., Newark, N. J., and New York City. The reports of these cities have been thoroughly studied in a series of monographs by Dr. Frederick S. Crum on epidemic diseases in the United States.† Since the endorsement of the Model Bill in 1913 for the reporting of a number of communicable and other diseases, a nation-wide revival of interest in disease registration has taken place. In 1916 an "Area of Known Disease Prevalence" was proposed and in 1917 a set of standard morbidity tables was endorsed for use in presenting the data of reportable disease. This recent work of developing fairly satisfactory statistics of sickness by continuous registration has been

* An excellent account of these Mayet tables may be found in the *Spectator* (N. Y.) for July 14, 1910.

†"Statistical Studies of Measles, Whooping Cough, Diphtheria and Scarlet Fever." Reprinted by the Prudential Insurance Company of America, Newark, N. J.

under the direction, and largely at the inspiration, of the United States Public Health Service.* There have been several endeavors to utilize the data of private medical practice and of hospital experience in the United States. These are discussed historically in Mr. F. L. Hoffman's "Statistical Experience Data of the Johns Hopkins Hospital, 1892–1911," pages 7 and 8,† and in United

From these preliminary historical remarks, it will be seen that States Public Health Reports, June 15, 1917.‡

there is a sound basis of much preparatory work in the United States and elsewhere for the discussion of a comprehensive plan of sickness statistics, a plan which will have for its aim the gathering of data on the occurrence, nature, duration and social consequences of serious illness. Let us examine the main characteristics and sources of sickness data, the technical methods for developing these sources and the end-results we may reasonably hope for.

Chief Characteristics and Limitations of Sickness Statistics.

Each of the fields or subjects of research in social statistics has its limiting definitions, its bases of agreement upon what constitutes and what does not constitute the fact under discussion. In mortality statistics. we have only to classify the individuals under observation as to whether they are alive or dead; the process of classifying persons as to whether they are sick or well, however, involves the prime difficulty of defining sickness and health "for purposes of this act." The life insurance actuary is concerned only with "the quick and the dead," but the casualty statistician and actuary, in compiling his crude descriptive data, must prepare to dispose, according to definition, of the numerous states of being in between undoubted health and undoubted sickness; furthermore he must distinguish the transitory or temporary sickness or injury from the sickness which is prolonged, or which becomes permanent in its effects.

If we include injuries and the effects of injuries, and mental diseases, our term "sickness" may be defined as any objectively

* *See:* Dublin, Louis I. "The Reporting of Disease: the Next Step in Life Conservation." Assn. of Life Insurance Presidents. 1914.

† Johns Hopkins Hospital Reports—Monographs. New Series, No. IV.

‡ Also as Public Health Reprint No. 402. Gov't Printing Office, Wash., D. C.

or subjectively apparent abnormality or anomaly of structure or function of the human body or of its parts.

Perhaps the most satisfactory fundamental approach to a statistical study of sickness is to establish two practical, however arbitrary, classes of such abnormalities or anomalies of structure or function of the human body or of its parts; the first class should include those sicknesses which impair living and working efficiency, or which endanger the wellbeing of others (as, for instance, communicable diseases), and the second, those diseases and conditions which have no appreciable economic or social effect upon the life or work of the affected person. The second class we can reject at present from our statistical group of "sick" persons. This latter group of illnesses, while of interest to the practitioner of medicine, will probably continue to elude serious statistical study, and our inquiries had better be confined to the first class of totally or partially disabling sicknesses and injuries. Wherever the second group of illnesses enters into a mass of cases, it should be segregated and studied independently, if at all.

Further Classification of Serious Sickness and Injury According to Degree and Duration of Disability.

In the first category of serious sickness we place abnormalities or anomalies of bodily form or function which impair living and working efficiency; in other words, we segregate those sicknesses or injuries which interfere with the earning of the livelihood of persons gainfully employed, or with the other daily pursuits of life, such as school attendance in the case of children, or household duties for domestically occupied women. This impairment or disability may be either *partial* or *total*. Partial and total disabilities may be either *temporary* or *permanent*. (This nomenclature is, of course, common to the field of workmen's compensation statistics.)

The oldest tables of sickness we have at hand, those of Price, deal with sickness involving "incapacities of labour, produced by sickness or accidents." The incapacity was further classified as warranting benefits of "bed-lying pay" and "walking pay."* Our modern classification of sickness or injury according to extent of disability, and as to bedfast or ambulant nature, are evidently not new!

* Price, *op. cit.*, p. 474.

Let us view the sources of sickness data, and in connection with each of the sources, the technical problems of compiling the facts for the use of public health officials, social economists, insurance technicians and other students.

Sources of Data Suitable for Statistical Study of Sickness.*

The several sources of sickness data from which it is practicable to secure fairly satisfactory returns for statistical purposes are shown categorically below. Each of the sources has its peculiar excellencies and deficiencies and these must be taken into account.

Sources of Statistical Data on Sickness.

I. General population experience.
   - *a.* Continuous registration of sickness and other causes of physical disability.
     1. Communicable diseases.
     2. Other reportable diseases.
     3. Accidents.
        Industrial accidents.
        Traffic or other highway accidents.
   - *b.* Enumeration of sickness by the census method.

II. Experience of special groups in the population.
   - *a.* Hospitals and other institutions giving medical, surgical or nursing care.
     1. General hospitals.
     2. Special hospitals and sanatoria.
        Tuberculosis, cancer, mental diseases, drug addiction, factory hospitals.
     3. Dispensaries.
     4. Convalescent homes.
     5. Correctional and penal institutions.
     6. Institutions for the aged and for the infirm.
     7. Public health nursing experience.
   - *b.* Army and navy medical, surgical and sanitary service.
   - *c.* Health and accident insurance societies and companies.
   - *d.* Industrial groups under medical and insurance observation.
   - *e.* Private medical practice.

* In the succeeding text, for purposes of brevity, sickness will be taken to include injuries and effects of injuries.

Let us view in detail some of the principles and practice of descriptive sickness statistics when considered according to this classification.

I. General Population Experience.

Continuous Registration of Sickness in General Populations.

The continuous registration of a limited number of diseases had its origin in public dread of certain diseases such as Asiatic cholera, yellow fever, smallpox and malaria.* The work by Dr. Trask, cited below, gives a full historical note on the development of continuous registration of sickness and on the expansion of the list of notifiable diseases with the evolution of American public health administration.

The essentials of continuous registration of sickness recognized in modern American vital statistical practice are set forth below:

1. The combined voluntary effort and co-operation of the states in the enactment *and enforcement* of a uniform, or model, law.

2. A standard reporting blank, providing for items such as sex, age, occupation, residence, diagnosis, etc.

3. Compliance with the law by physicians, householders and others charged with the duty of reporting.

4. Tabulation and publication of the data reported to the U. S. Public Health Service for areas with fairly satisfactory registration conditions, including facilities for verifying diagnoses and reports. Tabulation practice should follow accepted standards.†

With these essentials provided for, we may expect the following data which are common also to nearly all sickness statistics:

a. Attack, or morbidity, rates of various diseases and conditions according to sex, age periods, geographic areas (even sections of cities and classes of housing accommodation), season of year and, perhaps, occupation (for industrial accidents and diseases).

b. Fatality, or lethality, rates of various diseases and conditions according to the categories enumerated in (*a*). It is assumed for purposes of computing fatality rates that there is satisfactory registration of deaths and certification of diseases causing death.

* Trask, J. W., "Vital Statistics. What they Are, and their Uses in Public Administration." Supplement No. 12 to the Public Health Reports, April 3, 1914. Government Printing Office, Washington, D. C. 1914.

† U. S. Public Health Reports, "Standard Morbidity Tables," May 25, 1917, Vol. 32, No. 21, p. 773.

Attack or *morbidity rates* are computed by relating the cases recorded to the population exposed. *Fatality* or *lethality rates* are computed by relating the deaths reported for any disease to the cases recorded. *Attack* or *morbidity rates* are usually expressed as "per 100,000 population exposed" and *fatality* or *lethality rates* as "deaths per 100 cases."

c. Morbility rates, or the number of days of sickness (or of physical disability) per year per person exposed, are not yet available from data collected through continuous registration, nor is it feasible at present to expect from these sources any facts on the *average number of days of sickness per case recorded.*

It is also not practicable to make a distinction in these statistics of notifiable diseases and conditions between attack rates based upon separate *cases* reported and attack rates based upon separate *persons* affected. The ratio of a morbidity, or attack, rate for cases to the morbidity or attack rate for persons affected is called the *morbidity coefficient.* Since, in all sickness experience, the number of cases of sickness is either equal to or greater than the number of persons affected, the value of the *morbidity coefficient* is either unity, or greater than unity.

d. From statistical data of the notifiable diseases, and, in general, from all sickness data, we may compute also another value, the *daily average number of persons (or cases) sick.* This average is related in conventional practice to each 1,000 persons exposed, i. e., the full expression for this concept is: "*daily average number of persons (or cases) sick per 1,000 exposed.*"

(*e*) *Mortality rates,* or the number of deaths from various or all diseases or conditions per unit of population exposed, are also computed in sickness statistics. These rates are most often expressed "per 1,000 exposed" for all diseases and conditions combined and "per 100,000 exposed" for specific diseases and conditions. The distinction between *mortality* rates and *fatality* or *lethality* rates must be kept in mind.

It should be remarked that the ratios or averages in (*a*), (*b*), (*c*), (*d*) and (*e*) should be made available for disease, sex and age categories.

When the statistical practice of workmen's compensation and industrial accident boards shall have been standardized, the facts for work-accidents will become available by the process of continuous and uniform registration. Traffic and highway accident sta-

tistics are being made available through publications such as the 1915 and 1916 Reports of the New York City Police Department.

We have thus briefly viewed the subject of descriptive sickness statistics arising out of continuous registration processes in general populations.

Enumeration of Sickness by the Census Method.

Statistics of mortality, unemployment and sickness have been collected more or less successfully by the ordinary method of house-to-house census inquiry. The collection of mortality statistics by this method has been definitely abandoned because of gross deficiencies in registration. The attempt to register all the deaths which occurred in any one habitation during the twelve months ending with Census Day is not likely to lead to satisfactory results. The registration of social disabilities existing on a Census Day, such as unemployment and serious, disabling sickness, may be expected, however, to yield a larger measure of success. In fact, census inquiry into unemployment leads, with respect to causes of unemployment, to a fair registration of disabling sickness.

It has been argued that an enumeration of sickness according to diseases and conditions causing disability would be so fraught with evasion and misstatement as to render the results utterly worthless. This objection to sickness enumerations is of more than half a century's standing. Answering the assertion that a sickness census according to diseases was impossible, Miss Florence Nightingale,* in urging such an enumeration upon officials in charge of the 1861 Census of England and Wales, said: "The 'diseases' can be approximated also. In all the more important—such as smallpox, fevers, measles, heart disease, etc.—all those which affect the *national* health, there will be very little error. Where there *is* error, the error is uniform . . . and corrects itself. . . ."

There is in the plea for sickness enumeration by the census method no assertion that the data so collected are in any way more than approximations of the amount and character of serious sickness—sickness "which affects the national health." Considered with due temperance as approximations, the data of a properly conducted sickness census have important uses. There are definite principles to be observed in sickness census practice, and these are stated below:

* Cook, Edward T., "Life of Florence Nightingale," Vol. I, p. 437, MacMillan, 1913.

1. Certain areas must be selected and a thorough publicity campaign on the purposes of the census should be carried on. The field must be prepared for the enumerator.

2. The facts must be recorded only for whole families who express willingness to impart the necessary information. Compulsion will probably yield no results. The figures obtained should be qualified as applying to *all* persons, in families enumerated, subject to no factor of selection save that of intelligent co-operation with the enumerator.

3. The enumerator should register for both the sick and the well such items as sex and age; for the sick he should obtain a statement of the nature of the illness (physician's statement of diagnosis, if possible) and whether the sick person is able or unable to work. It might be desirable to ascertain, also, the duration of the sickness up to the date of the inquiry and whether a physician is in attendance.

The Metropolitan Life Insurance Company has demonstrated that a carefully directed sickness census can yield results of use in studying community loss from serious sickness.*

The results of sickness inquiries by the census method may be outlined briefly as follows:

1. On the basis of suitably classified numbers of persons exposed (including both the well and the sick) and numbers of cases of serious (disabling) sickness, rates may be computed to show the prevalence of sickness per 1,000 persons enumerated on the day of inquiry. It would suffice to limit the tables to a classification of main geographic areas according to sex and age classes for all serious (totally disabling) sicknesses combined.

2. The diseases and conditions reported for disabling sickness should be classified and rates should be shown for these diseases only for the important item of sex. The several disease titles may be simply classified, also, according to age incidence and perhaps according to duration of sickness (or of disability, if that fact is ascertained).

3. If the enumeration is made in the spring, it may be safely assumed that the sickness rates developed are at a maximum for the year. Upon this rational assumption, an approximation of

* Frankel, Lee K., and Dublin, Louis I., Seven Sickness Surveys in Representative American Communities. Published as reprints by the Metropolitan Life Insurance Company, New York, 1915 to 1917.

the number of days of disability per person exposed in any sex or age class may be reached if we regard each rate to be, for that purpose, the "daily average of persons sick per 1,000 exposed." The rate is multiplied into an assumed work-year of 300 days and the result is divided by 1,000 to obtain the estimated number of days of disability for work per person exposed. The resulting figure should be qualified as a conservative estimate of *at least* that "average number of days lost per person exposed."

Since characteristics of the method of inquiry and the other limiting conditions apply with equal force to the several geographic, sex and age classes of the data, the results of a sickness census should have value for comparison of the several classes so established within the census material.

II. Experience of Special Groups in the Population.

We have briefly reviewed the two chief methods of collecting the sickness experience of a general population, first, by continuous registration throughout the year and, second, by inquiry into sickness existing on an enumeration day. There are other sources of sickness data.

Special groups of the population are continually under sickness observation. There is, for instance, the population of general and special hospitals, of convalescent homes, of correctional and penal institutions, of armies and navies in times of peace and war, of industries under medical and insurance observation, and of schools. We have also to consider the groups under the observation of companies, orders, and societies conducting a health insurance business and the groups under the care of public health nursing societies. The experience of private medical practice is also a potential source of sickness data. Each of these sections of the population has sickness experience with distinctive characteristics. We cannot consider that the data of any one group cover the whole problem of sickness, however. We may consult the experience of each group for answers to a few of the innumerable questions which arise in a thoughtful study of the various facts of the social problem of sickness.

The most accessible body of data on sickness in any special group of the population is that in the experience of

General Hospitals.

General hospital service deals with the two classes of sick cases we identified in our introductory remarks—the able and unable to work. The able to work cases, and ambulant patients unable to work, are usually treated in the outpatient or dispensary department. The ward and room service deals for the very largest part with bed-patients disabled for work. In order to render statistical data for general hospitals basically comparable, the outpatient service should be studied separately and perhaps arranged for comparison with general dispensary data.

The ultimate uses of hospital sickness experience data determine the scope and methods of tabulation practice. The several main fields of service for nosocomial data are:

1. Advancement of medical and surgical science.
2. Public health administration.
3. Hospital management.
4. Social economy and medical economics.

1. Carefully prepared statistics of sickness under hospital care have in the past pointed out numerous advances in the prevention and treatment of the several diseases and conditions. Records of experimental courses of treatment such as serum therapy for infections and special expedients in surgical conditions have each been subjected to statistical analysis. Judgments on the efficacy of such courses of treatment have been based upon sound statistical demonstration. The tabulation programme for such studies is quite simple. Diagnoses are classified by sex and by age periods; lethal, recovery and other discharge rates are computed upon the basis of cases treated and the numbers discharged. The average and classified durations of cases in similar diagnosis, sex and age classes are derived.

Where important medical and surgical conclusions are to be drawn from statistical evidence, the careful statistician should employ the special analytic agencies of his art for testing the reliability of such conclusions. Many false conclusions find a way into the literature of medicine and surgery because of inexpert, incautious statistical analysis.

Perhaps the most striking example of the service which statistics, especially higher statistical analysis, can perform in medicine and surgery is the work of Pierre LeCompte Du Noüy, who developed

a "law of cicatrization" of wounds from the statistical data of the war Hospital No. 21 at Compiègne, France.* Numerous other examples could be given of distinguished services by thoroughly trained statisticians toward the advancement of medical and surgical science, founded upon properly prepared and analyzed hospital experience data. The statistical method applied in group case-analysis leads, therefore, to sound generalizations in the study of healing processes as physico-chemical phenomena. It is perhaps appropriate to suggest here the intensive statistical analysis of surgical experience with workmen's compensation cases.

2. Public health administration requires the experience data of hospitals for purposes of gauging the effect of an improvement in hospital methods in diseases such as pneumonia, typhoid fever, peurperal sepsis and its prevention, dispensary care of tuberculosis, and surgical procedures of various kinds, upon the mortality rates for these diseases.

Hospital observation on the gravity of types of cases admitted, as in syphilis, forms the basis for concluding whether the severity of several important infectious diseases is increasing or decreasing with the years. G. B. Young, for instance, concludes from the U. S. Public Health Service Hospital data for the Marine Hospital station at Chicago, that the milder lesions of luetic infection are becoming increasingly more common in proportion among hospital admissions for syphilis.

3. The statistical data of hospitals are practically indispensable in establishing administrative programmes for these institutions, for outlining broad policies governing types of cases to be admitted, for testing the effectiveness of the several systems of nursing and of established modes of treatment in relation to hospital costs.

4. Much information is at hand also in well-kept hospital records (especially for institutions such as the Massachusetts General Hospital which maintain efficient departments of social service work) on the economic and social status of patients. It should be possible to relate hospital costs to the facts of the social diagnoses of the cases, as well as to the end-results of the strictly medical problems of the patients. Finally, only hospital data of sufficient variety and of proper quality will throw light upon the social economy of medical and surgical benefits under workmen's compensation acts,

* See *Proceedings*, Vol. III, p. 269.

as indicated by Dr. Rubinow in his "Medical Benefits under Workmen's Compensation."*

Special Hospitals and Sanatoria.

Institutions specializing in the care of single diseases or conditions, or of closely related diseases or conditions, have abundant opportunities for statistical research into the broad principles underlying the causes, the treatment and the prevention of the diseases within their purview. The hospitals for mental diseases under the State Hospital Commission in New York and the Board of Insanity in Massachusetts have made substantial contributions to our knowledge of these diseases. Statistical study of masses of cases has lead to important advances in the hospital treatment of mental diseases. Further progress may be expected to follow the plans of statistical case study at present under consideration by the American Medico-Psychological Association. The same observations as to adequately displaying the data according to diagnoses, specified in terms and titles of an approved nomenclature and classification, and under sex, age, duration of treatment and condition on discharge classes, apply to the statistics of special hospitals as to the data of general hospitals. Uniformity in the basic elements of all hospital statistical data is, of course, imperative. The tuberculosis, cancer, maternity, drug addiction and other special hospitals having bed-patient service may all contribute to our growing store of statistical facts on sickness.

Dispensaries.

Considerably more than 2,000 dispensaries in the United States administer medical, surgical and nursing service to ambulant cases of sickness. These cases involve both capacity and incapacity for work.

We have seen that bed-service of general and special hospitals will give us data only for bedfast, disabling illness. Hospital statistics therefore portray only part of the problem of sickness. There remains the larger number of serious ambulant cases. The medical observation and treatment of these cases are either carried

* Rubinow, I. M., "Medical Benefits under Workmen's Compensation," *Journal of Political Economy*, Vol. XXV, No. 6, June, and No. 7, July, 1917.

on by out-patient services of hospitals, by separate dispensaries, or by private physicians as office practice. The most promising source of data on ambulant sickness is the experience of well-ordered dispensaries and out-patient services such as the Boston Dispensary, where, in 1916, nearly 25,000 new patients were served in the out-patient department.

The collection of the facts for a representative number of these services would serve to advance our knowledge of serious ambulant sickness. The data should be displayed according to whether the sick person, if an adult, is (*a*) disabled for work or (*b*) not disabled for work. The facts for each of these categories should, of course, be qualified for diagnosis, sex and age characteristics and, perhaps, for duration of the sickness (or of disability for work) in the same uniform manner outlined for general and special hospital bed-patient service.

Social Statistics of Dispensary and Hospital Service.

In the fourth section on sickness data of general hospitals, it was suggested that facts on *all* the chief aspects of the sickness problem be collected. The statistics of sickness should not stop at the medical or surgical data; the sickness itself is often only a single element of a fourfold problem. Most cases of serious sickness require (*a*) medical, nursing or surgical attention, (*b*) convalescent or aftercare, (*c*) solution of a social problem, i. e., stresses such as acute or chronic poverty, undesirable home conditions (bad housing, delinquency, other illness in the home), industrial superannuation, or other situations exist which make for recurrence of illness or retardation of recovery, and (*d*) education of the patient, of members of the family and of the community in the prevention of further sickness.

No sickness statistics may be considered even fairly complete unless representative data on the other parts of the sickness problem are presented with the strictly medical and surgical facts. Dispensaries, hospitals and other institutions with social service or follow-up departments should ascertain the aftercare needs, the social diagnoses, and the educational or preventive aspects of their cases. Analysis of uniformly recorded observations may be "scaled" after a manner advocated by the Department of Research of the Whittier School in California.*

* Williams, J. H., "Whittier Scale for Grading Home Conditions," *Journal of Delinquency*, November, 1916, p. 273.

The aim of sickness statistics should be the accurate extensive portrayal of sickness in its four-fold aspects. Until reasonably adequate statements of the facts under each of these heads are available, we must not assume that we know anything about sickness as a social problem.

Convalescent Homes.

In the present state of our ignorance of the elementary social facts of sickness, we do not know, for one thing, the period of convalescence or aftercare for the important cases of sickness which pass out of hospitals, dispensaries and private medical practice as "relieved" or "apparently cured." The exigencies of hospital economy demand that "chronics" and convalescent patients be reassigned to some sort of institutional care characterized by low unit cost.

It is only a matter of speculation today how much the burden upon the general hospital systems of the United States could be eased, if the facts of low unit-cost aftercare were made available. The study of data for general and special hospitals should be supplemented by a collection of the important facts for convalescent care, related, of course, to the same elements of statistics prescribed for these general and special hospitals.

Correctional and Penal Institutions.

The sickness and disability experience of correctional and penal institutions should be made part of a programme of the general vital statistics of such institutions. Without a proper understanding of the vital constitution of the population confined in these institutions a number of pressing problems must remain unsolved. The sickness data are of special importance in ascertaining the possible connection between certain abnormalities or anomalies of the structure or function of the human economy and the tendency toward anti-social conduct.

Institutions for the Aged and for the Infirm.

The science of geriatrics, or the special study of the diseases of old age, is of comparatively recent origin. The growth of this specialty in medicine has brought with it a demand for the collected sickness experience data of institutions for the aged. The same statistical elements apply to facts for these institutions as to general and spe-

cial hospitals. There are also possibilities of collecting qualitative social data on superannuation, old-age dependency and family disintegration which must not be overlooked.

Institutions for those persons permanently and totally disabled on account of sickness or injury have also a rich field of inquiry. Community attitudes toward the prevention and relief of permanent infirmities are still to be founded upon a summary and interpretation of current experience. There are also social data of much importance to be developed by inquiry into the facts leading to chronic infirmities and into the facilities and costs of present and prospective means of private and institutional care of the aged and infirm.

Public Health Nursing Experience.

The sickness data of public health nursing associations must be compiled on the basis and in the light of the special conditions under which each association must operate in the community which it serves. The fields of service, the attitudes of communities, the funding arrangements, the extent of hospital facilities and the administrative traditions and present policies of each association, are some of the circumstances which must be taken into account before any interpretation is placed upon the data of these nursing associations. Public health nursing in so many cities is the point of first contact between cases of sickness among the wage-earning groups of the population and the organized medical agencies of the community. When cases rightly come within the scope of public health nursing and under domiciliary medical observation, no further reference of the cases to hospital or other institutional means of combating sickness is necessary. The public health nursing societies therefore help to ease the burden which the needs of an increasing population place upon hospital facilities. It may be possible also to demonstrate from proper data that the nursing of certain diseases, provided home conditions are satisfactory, under the care of these societies, yields greater practical returns than can be obtained through other existing means.

Public health nursing data on the pre-hospital care of illness are also of great value. In fact, the public health nurse often performs indispensable service in securing proper hospital or convalescent care for cases which would in the ordinary course of events suffer for lack of such attention. The cases which continue

under public health nursing care afford information on sickness in the home which is not to be found in any other of our sources. *When properly classified as to type of case,* and further arranged according to diagnosis and sex and age, the facts of sickness recorded by these associations are uniquely valuable.

Army and Navy Medical, Surgical and Sanitary Service.

The "First Annual Statistical Report on the Health of the British Army," issued in March, 1861, and compiled by Dr. Thomas Graham Balfour, was, so far as the information at hand would lead us to believe, the first noteworthy endeavor in modern times to present the facts of serious sickness among armies. The medico-statistical reports of the armies of other countries are today also available and constitute a body of reliable data on sickness among a considerable number of adult males engaged in military service.

The annual statistical reports of our own Army are distinguished contributions to American demology. They present, for instance, the only reliable and conveniently available facts on the efficacy of anti-typhoid inoculation and of anti-malarial measures. The experience of armies in certain medico-surgical and sanitary procedures has often proved the source of inspiration for similar enterprises in civil life. The public health movement in America owes much to the medical and sanitary experience data of the War between the States. The experience data of armies and navies should therefore be considered seriously as part of the available supply of information on sickness. In fact, the favorable conditions existing in the national military establishment for continuous observation of sickness and of methods of treatment are without an equal in civil life. The Army observes and records *all* the important vital facts of its membership. The medical statistics of armies require but little qualification before being admitted freely to the general collection of facts on sickness. A few slight changes in the age classification and a display of disability figures according to *classified days of disability* are all that would be necessary at present to make the army data comparable with the tabulations proposed for civil sickness experience. Only slight use has been made by publicists of army and navy sickness data in this country, and when so made, the limitations as well as the special excellencies of the material were ignored.

Health and Accident Insurance Companies and Societies.

There is an unfortunate tendency to regard the statistics of sickness and accident claim experience as the practical equivalent of sickness statistics in public discussions on the economics and sociology of the sickness problem. Sickness claim experience, both as to rates of sickness and average or classified periods of benefit payment, is subject to many profound "artificial" disturbing factors in addition to the "natural" conditioning elements which qualify general sickness data gathered from non-insurance sources. Some of these factors found in insurance experience were enumerated by Francis G. P. Neison* as follows:

1. Methods of administration of the sickness benefits.
2. Density of population, and other community health factors, such as sanitation, modes and special conditions of urban and rural life affecting the membership of some but not of all Friendly or other insurance societies.
3. Hazards and hygiene of occupations.
4. Nature of occupations of the insured, i. e., an injury which would incapacitate a tailor would not interfere with the day laborer's work.
5. Inclusion, exclusion, or limitation of benefits to cases of chronic illness, or exclusion of cases of illness after a certain age; limitation of benefits to certain fixed periods regardless of "chronicity."
6. Relative incidence of illnesses of very short, reasonably short or of long duration in a complete experience.
7. Effectiveness of claim supervision.
8. The rate of unemployment.
9. The average wage of the insured, and the percentage of wages paid in sick benefits.
10. Personal equation of the sick person.

"It is astonishing under what real disability of sickness from the physiologist's standpoint the laborer will continue to work if not in a Friendly Society."

11. The resources of the society.

"The amount of the accumulated fund is likewise a factor in the cost of a sickness risk, for the larger the realized capital, the greater the tendency for a relaxed supervision of claims."

*"Assurance against Invalidity," *Transactions* of the Third International Congress of Actuaries, Paris, 1900, Documents, p. 109.

Loewy* indicates in addition the influence of sex composition of the membership and whether maternity benefits are included, the influence of waiting periods at the beginning of sickness or disability before benefit is paid, of the retroactive payment of benefit for the waiting period if the illness produces incapacity of more than a specified period, of the period of maximum benefit, of the inclusion of Sundays and holidays in the calculation of the days of benefit, of compulsory and voluntary membership, of a fluctuating or persistent membership list, of character of medical service, i. e., whether the certifying physician is employed by the insured or by the insurance institution, and of many unallocated external signs of simulation, *pension hysteria, "krankengeldhunger."* Any or all of these important "variants" of sickness claim experience may be present in our American data too, in addition to the "cancellation clause," indemnity limited to specified diseases, "frills," deliberate selection by self-solicited risks, etc.

There is food for reflection in the observations of these students of European sickness insurance experience.

Not all of the "artificial" factors are of the same importance; no one of them may be ignored, however, in the use of the European data so freely and unqualifiedly introduced into discussions of the problem of sickness in the life of the American wage-earner.

There are certain principles of procedure in the compilation of insurance sickness statistics which aim to offset in a measure the chief "artificial" variants. The statistical essentials are:

1. An "exposed to risk" classified according to sex and main age periods for "full-benefit" membership. If the membership is stable, this "exposed to risk" classification is simply the arithmetic average for a calendar year of the existing monthly, quarterly or half-yearly membership rolls. If the membership or exposure fluctuates decidedly, as it did in Bleicher's *Frankfurt* and *Bockenheim* society, the number of membership-years or the $\frac{\text{membership-days}}{365}$ must be used. Bleicher was the first investigator on record to use the membership-year base for the computation of sickness rates (1896).

For a society where premiums cease with the beginning of disability for work, provision must be made for the inclusion of the

* "Grundlagen der Krankenversicherung," in *Jahrbuch für Versicherungsmathematik*, 1914, p. 276. Deutsche Versicherungs-Presse, Berlin.

exposure-days of persons receiving benefit, with the exposure-days used in computing the sickness rates.

2. The number of separate *cases* of sickness should be classified apart from the number of separate *persons* taken sick. (The ratio between the two figures for purposes of record is known as the *morbidity coefficient.*)

3. The days of sickness involving total incapacity for work should include Sundays, holidays and waiting or "karenz" days, and should extend from the *beginning to the end* of the sickness. The physicians' final diagnoses are to be reported and classified in accordance with an accepted nomenclature and classification of diseases and conditions.

4. In agreement with groupings of the "exposed to risk," suitable classifications may be made of the:

(*a*) Number of cases of disabling sickness.
(*b*) Number of persons disabled on account of sickness.
(*c*) Number of days of sickness.
(*d*) Number of days of sickness benefit.
(*e*) Number of deaths.
(*f*) Diagnoses, for number of cases of sickness, number of persons sick, number of days of sickness, number of days of sickness benefit and number of deaths.

Industrial Groups under Medical and Insurance Observation.

The work of Schereschewsky,* Dublin and Harris,† Landis and Reed‡ and Robinson and Wilson§ in the analysis of physical examination data for workers in typical American industries point to the possibilities of standardizing the methods of examination and of analyzing the data. Physical examinations, including any facts disclosed upon follow-up work, give a cross-section view of the health of workmen *able to work.* Such data can not be expected, however, to supply the facts for members of an industry incapaci-

* Schereschewsky, J. W., "Health of Garment Workers," Bulletin 71, U. S. Pub. Health Service, 1915.

† Dublin, L. I., and Harris, L. I., "Health of Food Handlers," N. Y. City Dept. of Health Monograph Series, No. 17, August, 1917.

‡ Landis, H. R. M., and Reed, J. S., "Factors Affecting Health of Garment Workers," Henry Phipps Institute, 1915.

§ Robinson, D. E., and Wilson, J. G., Bulletin 73, U. S. Pub. Health Service, 1916.

tated for work. The statistics of industrial benefit funds, as cited by Hoffman for the employees of the Bethlehem Steel Company,* period 1903–1913, provide information of rare value. The collection of the experience data of these funds *in conformity to standard methods of statistical study* would constitute a body of data of the first importance in the study of sickness among American wage-earners. The American Association of Industrial Physicians has under consideration the question of medical examination standards; the field of this inquiry might be broadened so as to include standards for the medical statistics of industry available in the experience of benefit funds.

Private Medical Practice.

At the Philadelphia meeting of the American Medical Association in 1855, a resolution was offered by Dr. J. W. Thomson, and adopted by the Association, which provided:

"That . . . this association appoint a special committee for each State and Territory . . . whose duty it shall be to report its medical topography, epidemic diseases, and the most successful treatment thereof. . . ." At the same meeting Dr. J. G. Orton of Binghamton, N. Y., introduced a supplementary resolution, which appears not to have been adopted, and this resolution was substantially as follows:

"That each county medical society or . . . any duly organized medical association be requested to amend its constitution by attaching thereunto the following article:

"It shall be the duty of each member of this society to keep a faithful record of the diseases which may fall under his observation during each month, according to the classification adopted by this convention in May, 1847, *stating the age and sex, occupation and nativity of the patient, the average duration of the disease, and finally their recovery or death,* and report the same in writing to the secretary, on or before the first day of February of each year, who shall transmit a digest thereof to the State Medical Society, and also to the appropriate committee appointed by the American Medical Association for its reception."†

In the *Transactions* of the Medical Society of the State of New York, 1859, Dr. Thomas E. Brinsmade of Troy gave a classified

* "Practical Statistics of Public Health Nursing and Community Sickness Experience." Prudential Insurance Company of America reprint.

† Trask, *op. cit.*, pp. 29–30.

summary of 8,195 cases of sickness occurring in his practice during the period 1837 to 1857.* There are, therefore, notable precedents for a study of the experience data of private medical practice. In view of the importance of information which could be gleaned from properly recorded and tabulated facts of the experience of private physicians, some effort should be made by county medical societies to collect the facts, if only for the cases under treatment on a certain day, or within a certain week.

General Technical Problems of Descriptive Sickness Statistics.

We have considered in detail the contemporary sources of sickness data. There are, however, some technical considerations which underlie all sickness experience. There is first the problem of a proper nomenclature and classification of diseases and conditions including injuries and the effects of injuries.

In the preface of the first edition (1869) of the nomenclature of diseases prepared by a Joint Committee of the Royal College of Physicians, London, we find a brief declaration of the purposes of a system of nomenclature of diseases:

"For perfecting the statistical registration of diseases, with a view to the discovery of statistical truths concerning their history, nature and phenomena, the want of a generally recognized nomenclature of diseases has been felt as an indispensable condition." This preface states further that "among the great ends of such a uniform nomenclature must be reckoned that of fixing definitely for all places the things about which medical observation is exercised, and of forming a steady basis upon which medical experience may be safely built."

We have available today a number of more or less related systems of nomenclature and classification of diseases. The one most generally recognized is the "Manual of the International List of Causes [of Sickness and] of Death: based upon the Second Decennial Revision by the International Commission, Paris, 1909." This list is in the direct line of descent of the nomenclature prepared by Drs. Farr and d'Espine, as authorized by resolution of the International Statistical Congress, Brussels, in 1853. The nomenclature employed by Bellevue and Allied Hospitals, New York City, revised in 1911 to conform to the International List,

* Hoffman, "Statistical Experience Data of the Johns Hopkins Hospital," *op. cit.*, p. 8.

is the one at present most in favor for purposes of hospital sickness statistics. The existence of other and supplementary systems of nomenclature and classification, each with its special excellencies, suggests the construction of a standard manual for American use, based upon agreement between the several systems. Attention is directed to the possibility of combining the joint excellencies of the forthcoming report of the United States Public Health Service Board of Nomenclature, the United States Public Health Service tentative nomenclature of diseases and conditions and of parasites and parasitic diseases, the United States Navy classification of injuries, the nosologic system of the International Commission for the Unification of the Medical Statistics of Armies (Berlin agreement, 1907), the International Association of Industrial Accident Boards and Commissions' classification of injuries (by location, nature, and extent of injury and degree of disability), and the International List of Causes of Sickness and Death as used by the Census Bureau, the United States Army, Massachusetts General Hospital, and by Bellevue Hospital.

The classification used by the Imperial Health Office of Germany differs in no essential respect from the Bertillon, or International, Classification* and may be included for consideration with these other systems. The American Public Health Association Committee on the Accuracy of Certified Causes of Death has issued a revised report (*U. S. Public Health Reports,* Sept. 28, 1917) which should also be seriously considered in an endeavor to devise a nomenclature suitable for the general purposes of sickness statistics.

Classification of Sickness According to Gravity or Severity.

Another essential technical aid in the compilation of sickness statistics is a system for classifying sicknesses according to gravity. In tuberculosis work, we have the scaling or "stage" system of the National Association for the Study and Prevention of Tuberculosis. This system essays to divide cases according to degree of pulmonary involvement. Mr. Downey and other members of this Society's Committee on Workmen's Compensation Statistics have been at work for some time upon the problem of establishing some

* Bertillon, Jacques, "Classification of the Causes of Death," *Transactions,* XV International Congress on Hygiene and Demography, Vol. VI, p. 53.

scale for the gravity of injuries. The entire problem of "scaling" sicknesses, injuries, and the effects of sicknesses and injuries, is still open. It affords a fertile field for continued research. There is as yet no agreement as to whether the classification, scaling or grading of sickness shall be based upon the pathology or the symptomatology of a case, or upon the economic effects, i. e., loss of working time. In the preceding discussion, sicknesses were assumed to have been fundamentally divided according to whether the affected persons were (*a*) able and (*b*) unable to work. No attempt was made to provide for partial disability for work. This consideration must be left until the entire problem of scaling sicknesses and other causes of disability has been adequately covered.

Nomenclature of Social Disabilities Necessary in Study of Sickness.

Nomenclature of the social disabilities discovered in association with serious sickness is also of basic importance. The proper study of social difficulties is conditioned by the methods and results of social diagnosis. This includes of course an approved nomenclature and a classification of social disabilities and difficulties for purposes of social statistics. Miss Mary E. Richmond* in a recent work defines the principles of social diagnosis and provides a basis for a standard nomenclature and, later, for a classification of social disabilities. The Casualty Actuarial and Statistical Society of America Committee on "Social Statistics in the 1920 Census Year" is contemplating a tentative draft of such a nomenclature and classification, designed especially as an auxiliary to the study of sickness and other causes of destitution.

In a later effort, I hope to present a treatment of Part 2 of the general subject of this paper. In that discussion the statistical analytics of sickness, including some comment upon the methods of the Swiss School, will be taken up.

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

PROVISION FOR EXPENSES IN WORKMEN'S COMPENSATION PREMIUMS—JOSEPH H. WOODWARD.

VOL. III, PAGE 140.

WRITTEN DISCUSSION.

MR. ALBERT H. MOWBRAY:

Mr. Woodward points out that although there has been little discussion, except in life insurance, of the theory upon which premiums should be loaded to provide for expenses, the practice seems to have followed the simple hypothesis that expenses should, in general, be assessed in proportion to the value of the insurance benefits provided. Mr. Woodward does not lay down at the outset of his paper the hypothesis which seems to him the true hypothesis, but does say in the closing paragraph of his paper where he answers the charge that the proposed change would be criticized as involving discrimination: "But the real test of discrimination is whether or not those fundamental principles of mutuality which enter into all insurance are violated. And the test of mutuality is that each insured shall be charged as exactly as possible with the value of the benefit in his policy plus his share of the expenses assessed *in the proportion in which he has contributed to produce them.*" (Italics mine—A. H. M.)

This major premise being admitted, the fundamental principles of Mr. Woodward's proposals do not seem open to attack. There has been in life-insurance circles not a little discussion as to the validity of this theory when carried to its full extent. That is, it has been claimed that new business is of advantage to the company and, therefore, the acquisition expense should, in part, be paid for by old policyholders as well as by new policyholders. This problem, however, does not present itself in compensation insurance, and if we might be disposed to theorize on this subject we have, as Mr. Woodward points out, a practical competitive test which seems to determine upon what theory our expenses must be apportioned. That test lies in the possibility of self-insurance, open under the laws of most states, and, as Mr. Woodward points out, if the method of expense distribution is such that an undue proportion is placed upon a large employer, he will not insure.

So far as discussion has been given to the question of loading in compensation premiums this hypothesis seems to have been followed. For example, the Joint Conference of 1915 provided a graduated expense loading according to state in recognition of the fact that the expense in the different states was not proportional to the pure premium costs.

Following out this hypothesis Mr. Woodward analyzes expenses into four general divisions. There might possibly be a disposition on the part of some critics to quibble somewhat with this and point out, for example, that in the textile industry a single employee operates many machines, upon all of which there are exposed gears, and that the accident prevention work in this classification is, therefore, much more costly than would be the accident prevention work in some other classifications which carry higher rates and that the expense is proportional neither to the office premium, the pure premium, payroll or number of policies. For myself I do not believe serious objection can be taken to Mr. Woodward's analysis, which seems as complete as it is practicable to go.

For the sake of clearness and understanding of the subsequent work, it should perhaps be again emphasized that the percentages of expense as distributed in Table *A* on page 141 are with relation to the gross premium. And 40 per cent. of the gross premium being 66⅔ per cent. of the pure premium, Mr. Woodward's method of determining the standard charge per unit of payroll in his formula A_2 will perhaps be sufficiently clear.

Mr. Woodward uses the symbol p to represent the pure premium rate, and it should be clearly borne in mind that this refers, not to the basic pure premium, but to the actual pure premium for the state for which the rate is to be made after all modifications and adjustments of the basic pure premium have been made.

Mr. Woodward's table on page 144 is very interesting and illuminating as showing the inequity according to the hypothesis underlying his theory of expense distribution of our present methods. The table would have been more striking had he included a fifth column expressing the difference entering into the fourth column as a percentage of the gross rate appearing in the second column. I have done this with the following results for each of the pure premiums tabulated by Mr. Woodward:

Pure Premium.	Excess of Correct Rate over Rate by Flat Percentage Loading as Percentage of Correct Gross Rate.
.05	50.3
.10	31.6
.25	12.2
.50	3.1
.75	0.0
1.00	—2.5
2.00	—5.0
5.00	—6.9
10.00	—7.6

Mr. Woodward's second proposal includes use of a policy fee and is more complex than the first, but follows consistently with his fundamental theory and is, as he notes, a further elaboration of the first proposal. Again, in the comparison on page 147 his results might be more striking if there had been an additional column expressing the value of the difference as a percentage of the rate computed by his method.

The percentages are as follows:

DIFFERENCES IN COLUMNS (4), (7) AND (10) OF TABLE ON PAGE 147 AS PERCENTAGES OF P'.

Pure Premium.	$W=5$. Per Cent. of (2).	$W=50$ Per Cent. of (5).	$W=500$. Per Cent. of (8).
.05	93.9	68.1	43.7
.10	88.5	50.2	24.9
.25	75.2	25.5	6.8
.50	59.5	10.9	−1.3
.75	48.7	4.6	−4.4
1.00	40.6	0.9	−6.2
2.00	22.6	−4.7	−8.5
5.00	5.5	−8.4	−9.1
10.00	−2.2	−9.8	−9.6

It is perhaps fair to say that the use of minimum premiums tends to make up the insufficiency of the charges on the smallest risks. The overcharge on the large high rated risks are not, however, taken care of on that basis.

Mr. Woodward points out the arbitrary character of the minimum premiums now being charged, and the way in which the loading for expense according to this theory will to a large degree avoid the necessity of arbitrary minimum premiums. In this connection it is perhaps well to note that the subject of minimum premiums is now under consideration after the minimum premiums determined by the recent Augmented Standing Committee has been subject to severe criticism by several insurance departments. Mr. Woodward's work in this connection, therefore, is very timely.

MR. VIRGIL M. KIME:

Mr. Woodward's article deals with a live subject. He discusses in an interesting manner one of the important problems connected with rate making for workmen's compensation insurance.

The paper is, I take it, largely suggestive. The author does not, apparently, propose for immediate adoption any particular method mentioned by him. It would be presumptuous, with our present knowledge of workmen's compensation insurance, to take in a discussion of his paper a definite dogmatic stand for or against

the loading methods reviewed. I shall, therefore, limit myself to what seem to me to be several important considerations in connection with the systems of expense loading described.

Mr. Woodward states that the expenses of providing workmen's compensation insurance may be analyzed into four general groups; those proportional to the office premium, to the pure premium, to the insured payroll, and to the number of policies issued, respectively. He then proceeds to derive formulas with illustrations, first assuming that expenses are allocated to the first three divisions only, and second that they are allocated to the four divisions. The result is, in either case, a system of expense loadings decreasing in proportion to the pure premium as the size of the pure premium increases.

Mr. Woodward's figures are illustrative in that he uses personal judgment in allocating the expenses into the various groups. Were either of his formulas used in practice, an investigation by the carriers of the incidence of their expenses would be necessary. In no event, however, is it at all likely that we should be able to effect an expense analysis without the use of considerable judgment.

Mr. Woodward indicates it to be a sound fundamental principle that where there is a doubt as to the basis on which expenses should be assessed, the doubt should be resolved by allocating as much as is reasonably possible in proportion to the value of the benefits insured. In classifying any element of expense, it is necessary to determine what causes a variation of that item of expense. If it varies with the number of policies, its classification is obvious. It is apparent, however, that the analysis problem is not nearly so simple. Who can determine, under general administration, for example, how much should be proportional to the number of policies, how much to payroll and how much to pure premium?

Every insurer must spend a certain sum for the underwriting of a policy, for the printing of the policy forms, for the entering of the policy on its books, for the recording of the payment of premiums, for the sending to the policyholder of all necessary forms and instructions, for the making of an inspection and a payroll audit. Obviously, there is a cost of each of these operations attaching to the very smallest policy. The question to be solved is simply where to draw the line between the constant cost, on the one hand, and the costs varying with the payroll, office premium or pure permium, on the other hand. Conditions will vary among the different carriers. The proper constant cost for one individual carrier will not necessarily be the proper one for another. Although a system of expense loading giving to carriers as a whole a proper aggregate for expenses can obviously be devised, does it follow that the same factors applied to each individual carrier will provide for its expenses without considerable excess or deficiency? We might conceive two carriers, one with a large number of small policies, the other with about the same volume of business in total

but with a small number of large policies. We might further consider that a loading factor proportional to the number of policies has been determined quite high. Is it not possible that the carrier of the large policies would find a considerable deficiency in his expense loadings?

It is necessary that a system of loadings be so devised that each carrier will collect for expenses a reasonable provision for such expenses. A cursory inspection of Schedules "*W*" indicates that even where the aggregate expenses are substantially the same percentages of the premium, there may be as between one carrier and another a considerable variation in the makeup of these aggregate expenses. A modification of the present expense loading scheme should not be attempted without consideration of these variations.

We should bear in mind that either of the plans outlined by Mr. Woodward is based upon the correctness of the pure premium, which, as he states, includes such factors as increasing cost due to industrial activity, due to age of act, etc. The recent conference on compensation rates gave quite a bit of consideration to the use of a graded expense loading in connection with a graduated differential. A combination of a single differential and a flat loading gave rates not varying considerably from those resulting from the use of a graduated differential and graded expense loading. If the errors arising out of the use of our present system of single differentials are substantially counterbalanced by the use of flat expense loadings our practical results are substantially equitable. A refinement of our method of loading must, consequently, proceed hand in hand with a refinement of our differential method and with a careful study of the actual incidence of expenses, not only in the aggregate, but with respect to individual carriers.

The use of a factor based upon the number of policies can be defended on many grounds. It might offer a solution, for example, of the minimum premium question, the minimum premium to consist of the premium produced by a certain minimum payroll together with a constant factor. On the other hand, there are many and manifest objections to the use of a constant factor, particularly if it be stated in the policy contract as a constant. The public has been educated under certain lines of insurance to look askance at any evidence of discrimination. Can we assume that the insuring public would acquiesce in any plan whereby the small policyholder would have to pay more for its protection per unit of payroll than would his large competitor?

If a constant factor per policy is to be used, its justification will rest upon the fact that a large part of it will be due to the actual cost of putting the policy in the hands of the assured and of carrying the policy on the books of the insurer. These expenses are incurred to a considerable degree whether the policy be carried to expiration or not. Would not the use of a constant factor make necessary a change in our methods of computing return premiums on cancellations before expiration?

The present system of expense loading results in a simple method of statement of premium. This should be departed from only for practical reasons.

Life insurance affords an interesting and instructive illustration of some of the principles involved. Loadings have usually in this country consisted of a percentage of net or gross premium or a percentage of net premium plus a constant per $1,000 insurance. Insurance departments have not looked with favor on a system of policy fees or constants. If life insurance with its long period of development and refinement has not found it practicable to vary premium rates by size of risk, we should proceed cautiously in the new compensation field.

I should not wish the above to be construed as arguments against Mr. Woodward's suggestions. The intention is merely, rather, to mention a few of the problems which must be considered along with the subject matter of his paper.

MR. CHARLES G. SMITH:

Mr. Woodward's logical and clear exposition of the problem of expense loading in workmen's compensation premiums records a distinct advance in the theory of rate-making.

The demand for a solution of the problem which Mr. Woodward has attacked may perhaps be traced back to the enactment of statutes providing for the approval of rates as to adequacy by supervising officials. As there is no absolute standard of adequacy which can be applied in advance, such officials are forced to rely upon composite or built-up rates; consequently they must scrutinize very closely each element entering into the finished rate. The general rate revisions have been of a semi-public character, and much attention has necessarily been given to the equitable treatment of the various industrial groups which are effected by compensation laws.

There is a more or less well-defined impression in the minds of many engaged in the business of workmen's compensation insurance to the effect that strict equity demands some method of loading which has regard for the small overhead cost of handling large amounts as compared with small amounts. Hitherto this idea has found its outward expression only in the present rather crude minimum premium device.

Whatever efforts have been made up to the present time looking toward a quantitative analysis of the problem of equitable expense loading have been hampered by the non-existence of reliable statistical data bearing on the various elements entering into the cost of writing policies and keeping them on the books.

I have little suggestion to make regarding the amounts of the different items of expense enumerated by Mr. Woodward and the proportions according to which he allots them to gross premium, pure premium, payroll and number of policies, since these are in-

tended mainly for illustration and depend largely upon individual judgment. These items could not be authoritatively determined except through a statistical investigation.

Mr. Woodward allocates acquisition expense so-called in proportion to gross premiums, since this expense is usually incurred as a percentage of such premiums. It might be questioned whether this is a valid reason for so allocating the whole of the item in question. The term "acquisition expense" has recently been the subject of considerable discussion, and there seems to be some ground for believing that commissions constitute only a part of the 17½ per cent. generally allowed, the remainder representing the cost of various kinds of "service" received by the assured. If such is the case, would it not be logical to allocate commissions to gross premiums, and the rest of the "acquisition cost" to pure premiums or payroll or in some proportion to both? In other words, perhaps these items ought to be allocated, not in proportion to payments to field representatives, but in proportion to the cost of service rendered.

Similarly it might be considered logical to allocate "adjustment expenses" in proportion to the number and not the amount of claim payments. This being impossible in practise, perhaps an approximation could be reached by a division of this expense between pure premiums and payroll.

One thought which impressed itself on me very forcibly on reading Mr. Woodward's paper is that some attention might well be given to the terminology which is springing up in the compensation field. The fact that a writer of Mr. Woodward's clarity of expression finds it necessary to pause as he does on page 144 and devote eight lines to an explanation of what he means by the words "pure premium" in this particular discussion is an index to the situation.

It is unfortunately true that we have "pure premiums" of many kinds, which are often mentioned indiscriminately: "basic" pure premiums, "experience" pure premiums for various states; "selected" pure premiums, found in the basic manual, not only containing the pure loss cost but reflecting the application of so-called "law-differentials," and of a factor to neutralize the effect of schedule rating. Then we have "reduction factors," factors for increased "industrial activity," "increased cost due to the age of the act;" we have "expense loading," covering some items perhaps not properly classed as expense, and applied to an imaginary premium which is not a "pure" premium (having concealed within it several factors beside actual loss experience), and which has no name; we have "acquisition expense" which is often accused of being a misnomer; we have Schedule P, Schedule R, Schedule W, Schedule Z, and even Schedule ZZ, whose names give no clue to their character and functions. Many other illustrations could be given if time permitted.

Many of the terms now used in compensation insurance have

sprung up haphazard in the necessity of the moment, and have received recognition without much consideration, for lack of something better. Those who have occasion to participate in the conferences which deal with the various phases of workmen's compensation insurance will probably not deny that there are times when not all of those present appear to be speaking the same language.

Perhaps the terms now in use might be standardized and defined with some precision, with proper regard for their inter-relation and for the future introduction of new terms.

It seems quite possible that unless more constructive effort is exerted in the development of a proper terminology in compensation insurance, the members of the statistical and actuarial profession will experience an ever increasing difficulty in discussing their problems and in presenting the results in a convincing manner to their non-technical associates.

ORAL DISCUSSION.

MR. E. H. DOWNEY: I wish to remark what may not be known to all the members here, that the Pennsylvania Bureau has adopted and put into effect on August 1 last a graduated compensation rate which conforms very closely to Mr. Woodward's proposal, except with respect to the policy fee; that is, the expense is divided into three elements. One element, proportionate to the gross rate, a second which is proportionate to the pure premium and a third which is a flat or a constant per hundred dollars of payroll. The effect of this scheme is to reduce the premium rate on the high rated classifications and to increase it upon the low rated classifications. The 10 cent pure premium produces a 27 cent rate on the Pennsylvania scheme.

MR. I. M. RUBINOW: Mr. Chairman, without discussing the details of Mr. Woodward's paper, I just want to add a word to emphasize the present tremendous importance of the subject, not only in graduating the premiums according to the level of the rates, but also as to the size of the risks. That is a consideration which Mr. Mowbray casually mentioned in his discussion but didn't sufficiently emphasize, I think, and that is that there is a very serious danger that a level expense ratio, which doesn't take into consideration the size of the risk, is going to act as a deterrent to the larger risks and force them to remain uninsured altogether. Now, that is not a theory but an actual statement of facts as I happened to find them in one of the western states in connection with some consulting work I have been doing—that the large risks (and it happened to be a state where all the substantial risks were very large indeed) were very much opposed to paying a rate of loading which they figured in dollars and cents would produce a sum which

they thought was unjustified in running the business of their risks. And the result, as far as I know, was that most of those risks remained uninsured.

You see, there is, after all, if you have no compulsory insurance —and practically none of our states have absolutely compulsory insurance, because there is always the alternative of self-insurance left in the laws, there is always the alternative between insurance and self-insurance or non-insurance, and the large risks which do run their business on strict business principles, with cost accounting, are going to wait and select the one of the two alternatives which is cheaper, and in that way the element that is decisive is the cost of running a benefit compensation department within the industrial undertaking. Practically one might say that anywhere from $5,000 up is the cost of running a compensation department. Now, $5,000 is a loading on the risk of about $12,000, and there are very many risks in this country which are charged $12,000 or over for their compensation insurance. So practically every one of those risks must consider the alternative of self-insurance, and the larger the risk, the stronger is the argument for self-insurance.

Now, besides the business point that in that way compensation insurance carriers may be deprived of the most substantial and profitable part of their business, there is also to be considered the general social point of view. I think this Society is particularly a proper field to emphasize the general social point of view of insurance. No matter how large a risk—I don't care how large a risk—self-insurance is undesirable on social principles. There is no absolute guarantee and permanency in any sort of an investment except possibly a Liberty Bond. A mine that is running at a profit of $1,000,000 a year may become exhausted long before the compensation payments have all been paid. So that there is a very serious social problem involved which I think ought to get the consideration of supervising officers just as much as a serious business problem involved things that must get the consideration of insurance enterprises, that is, that loadings must be graduated according to the size of the risk.

MR. JOSEPH H. WOODWARD:

(AUTHOR'S REVIEW OF DISCUSSIONS.)

I shall utilize my privilege of preparing a reply to these most interesting discussions almost wholly in commenting upon the points raised by Mr. Kime. This is not for the reason that I am insensible to the careful thought which the other reviewers have given to the subject but because, apparently, they have been so fully in agreement with the main principles developed in the paper that reply is uncalled for. Concerning Mr. Kime's discussion perhaps I should say that, in a general way, the matters which he

brings up were intentionally left untouched in the paper as it seemed desirable to present the subject in more or less academic form, ignoring for the moment certain inter-related problems the introduction of which might have tended to obscure the main issue.

Mr. Kime points out the difficulties of undertaking a true allocation of expenses. These difficulties are, of course, obvious. They do not, however, constitute an objection to a plan which, imperfect as it may be from the standpoint of ultimate equity, is nevertheless an improvement over existing conditions. For practical work we are dealing with questions of *relative*—not *absolute*—precision.

Mr. Kime points out that an examination of Schedule W shows "that even where the aggregate expenses are substantially the same percentages of the premium, there may be as between one carrier and another a considerable variation in the makeup of these aggregate expenses. A modification of the present expense loading scheme should not be attempted without consideration of these variations." If by this it is intended to be suggested that different expense loading formulae should be allowed to different individual carriers, based upon the experience of such carriers, I fear that I cannot concur with Mr. Kime's conclusions. A better adjustment of expense loading as between the high and low-rated risks and the large and small risks would tend to largely reduce these variations.

Mr. Kime introduces the moot question of the graded versus the constant differential as related to the loading formula. Referring to the recent rate conference, he says: "A combination of a single differential and a flat loading gave rates not varying considerably from those resulting from the use of a graded differential and graded expense loading." There is no doubt that the use of a constant differential in conjunction with a constant loading produces two sets of systematic errors in the rates, which, being in opposite directions, tend to counteract each other. As to the equity of the results actually obtained by this process there is good ground for difference of opinion. The prevalence in the New York exception sheet of high-rated classifications tends, in my judgment, to show in a very concrete way that the abnormally heavy loading on the high-rated classification was, in the case of New York State, not sufficient to offset the errors produced by the use of a constant differential. However this may be, it would appear to be unsound practice to trust that two errors in opposite directions, both of unknown magnitude, will even approximately balance each other throughout the wide range of values quoted in the rate manual.

In discussing possible objections to the introduction of a constant or policy fee into the actual premium Mr. Kime says: "Can we assume that the insuring public would acquiesce in any plan whereby a small policyholder would have to pay more for its protection per unit of payroll than would his large competitor?" The answer to this question depends entirely upon whether there is reasonable justification for such a condition. There are practically

no commodities which are dealt in commercially where retail prices are not higher per unit than are wholesale prices. To what extent insurance ought to be an exception to this well nigh universal rule depends upon the reasonableness of the arguments in any particular case.

Mr. Kime raises the interesting question of whether or not a constant addition to the premium might not make it advisable or necessary to change the customary methods of computing return premiums on cancellations before expiration. This is on the theory that initial expenses are largely incurred whether or not the policy is carried to expiration. As a practical matter, it does not seem to me that it would be necessary or desirable, certainly at first, to make any change in the customary methods of computing return premiums. It has never been considered good practice in this country to make any deduction from the premium reserve on the ground of initial expenses, and wherever cancellation is made on the instance of the company the full unearned premium should be returned.

"The present system of expense loading," says Mr. Kime, "results in a simple method of statement of premium. This should be departed from only for practical reasons." I am not sure whether this statement is intended to be for or against a departure from the simple method alluded to. Assuming, however, that it is intended to be in support of things as they are, my answer would be that the "practical reasons" sought by Mr. Kime not merely exist but appear to be growing daily more imperative.

A comparison with the methods followed in life insurance is introduced and perhaps it is well to say something on this point. The most widely accepted American method of loading life insurance premiums is to load the premiums on various forms of policy by a percentage of the net premium for the form in question plus a percentage of the net premium on an ordinary life form for the same age. This has the effect of producing a relatively smaller expense loading on the higher premium forms of insurance, which is precisely the purpose intended to be served by both the formulae given in the paper.

On the subject of policy fees Mr. Kime states: "Insurance departments have not looked with favor on a system of policy fees or constants." It is quite true that the policy fee has fallen into disrepute. It has most justly done so, however, since it has been subject to serious abuse, particularly in connection with industrial accident and health insurance, where it was used solely for the purpose of compensating agents and not with any view of securing greater equity in allocating the policy expenses. It was the practice to permit agents to retain the policy fees on any policies written by them, these sums in many instances being not even reported as part of the company's premium income. A condition of affairs was thereby created which offered special temptations to rebating

and other bad practices. Nothing of that sort could be alleged against the proposal made in the paper, and the sound and excellent reasons which have moved insurance departments to object to policy fees under other circumstances would not apply in this case.

Both Mr. Mowbray and Dr. Rubinow have emphasized the practical aspects of the expense problem as applied to the larger risks. While, of course, there are other elements involved in the consideration of whether or not a large employer will self-insure than the mere question of the expense loading in the premium, nevertheless, it would seem reasonable to suppose that a certain number of these large risks which were wavering between a decision to insure or not to insure would be favorably influenced by a more equitable assessment of the expenses. Dr. Rubinow points out the undesirability of self-insurance on social grounds, referring particularly to the lack of security for the payment of future installments of compensation where such payments run over a long term of years. Social welfare and the business profit of insurance companies are happily in accord on this problem, and, consequently, an active exploitation of the subject should almost certainly result in getting something done.

Mr. Smith raises some rather fine points in connection with the allocation of acquisition expense. This matter should, of course, receive careful consideration before any particular expense loading formula is adopted for practical use.

Mr. Downey mentions the interesting fact that Formula A, with suitable modifications in the constants, has already been adopted in Pennsylvania, where expenses are now assessed in three parts, one proportionate to the gross premium rate, the second to the pure premium rate, and the third a constant per unit of payroll. While it was not the purpose of the paper to urge immediate action, there would appear to be no good reason why a modified system of expense loading should not be adopted whenever the basic pure premiums may next be subject to revision.

Several of those discussing the paper have brought up the question of minimum premiums. It should, perhaps, be said that at the time the paper was written this subject had not become the extremely live issue which it has proved subsequently to be. While it is true that the adoption of a policy fee would be of material assistance in solving our difficulties in rating the very small risks, it seems to me that a word of caution should be given against expecting too much in this direction from this particular device. In addition to the proportionately greater expense of underwriting, issuing and maintaining a small policy, the difficulty in securing an adequate rate rests upon two other important considerations, (1) the practical impossibility of securing correct payroll statements upon these risks and (2) the excessive physical and moral hazard which it is generally believed that small risks as a class present. The weight of these two factors may prove so great as

compared with the weight of the expense factor that a solution of the problem purely along the lines of a re-assessment of expenses would not be satisfactory. What is needed is a greater volume of experience statistics showing loss ratios upon small policies taken as a class. This would enable the combined effect of the two factors above mentioned to be estimated and permit a solution of the matter more satisfactory than the more or less arbitrary solution which has recently been reached in several of the states.

GROUP LIFE INSURANCE AND ITS POSSIBLE DEVELOPMENT—EDWARD B. MORRIS.

VOL. III, PAGE 149.

WRITTEN DISCUSSION.

MR. H. PIERSON HAMMOND:

The paper which Mr. Morris read before this Society in April last on Group Life Insurance is an exceedingly valuable addition to the material available on this subject, and inasmuch as a committee of the National Convention of Insurance Commissioners was appointed at St. Paul in August to look into the subject of group life insurance and make recommendations for appropriate legislation, I think the author should be accredited with the production of a very timely paper. This Committee of Insurance Commissioners, with such actuaries as may be associated with it, should have for consideration all the information such as appears in our *Proceedings*.

Mr. Morris has set forth his views so accurately that one can hardly find much to discuss argumentatively, and little to criticize. Then, too, the ground is so completely covered from the point of view of the insurance company and the underwriter that there is little that I can say, except possibly to add some thoughts from the viewpoint of the insurance department official whose business is that of supervising, and not producing.

First, of what are we talking? What is group insurance? I do not believe that Mr. Morris's article offers a definition other than the general definition, namely, "the insuring of the lives of more than one hundred employees of a common employer." I know in my recent paper on the subject which I read at St. Paul, I intentionally did not offer a definition, and in the discussion of the paper which ensued no one asked for one, although I have asked myself this question many times. It may be that the development of group insurance has progressed for so limited a time that a proper definition to-day would not be a proper one to-morrow. Nevertheless, I submit for your consideration and criticism that group insurance is that form of life insurance which is written on a blanket yearly renewable term contract under which all or practically all of the employees of a single employer are insured for amounts either dependable on or commensurate with their yearly wages, and for the benefit of those other than the employer having insurable interest in the employees.

I think this definition reflects what has become to be known in this country as "group life insurance." It is *life* insurance still, and in view of the present statutory regulations, will probably remain so for some time to come irrespective of the present methods of inspection and selection. To my mind, the economic development of group insurance contemplates first a form of contract, the effective gross periodical premiums for which in the case of the average group remain practically the same year after year, and secondly, an assurance to the employee and his dependents that his wages for a period of time after his decease will be paid to his dependents.

I am fully aware that this definition does not cover a blanket policy written on any form other than that of a yearly renewable term contract and covering persons not employed in the same or similar pursuits. A blanket life insurance policy on any other form, I suppose, could be termed a "group policy," but within the confines of the economic and social developments as it has progressed thus far in the United States, such a term so applied, would, to my mind, be a misnomer. I think we should, as far as possible, follow the definition in practice, and, if occasion arises now and then for digression, let the exception prove the rule.

The Question of Selection.

Under this heading Mr. Morris discusses two points of particular importance. First, he says:

"A frequent form of request is that in addition to the group insurance the employer be allowed to purchase additional insurance at group rates for limited amounts. Such a concession is a dangerous one, unless accompanied by the requirement of a medical examination, for there is bound to creep in a certain amount of selection against the Company; for poor risks who are unable to obtain insurance elsewhere, are encouraged to avail themselves of such an opportunity."

I think that companies writing group insurance should come to an agreement among themselves concerning this phase of the subject, and possibly other matters. If they do not, I am apprehensive that in addition to the question of adverse selection, there may be some statutory regulation in the not distant future which will more or less limit the group contracts and the benefits and privileges incident thereto. I agree that such a concession as stated above is dangerous, and for the reasons named, but is it not more dangerous because of the possible violation of the anti-discrimination laws? Jones and Brown, each 35 years of age and married, live in adjoining houses, work in adjoining factories, at the same trade, and receive similar wages. Each takes out a thousand dollar life insurance policy, the contracts being identical and issued by the same insurer, except that Jones's premium is less than that

of Brown. What defence has the insurer before an insurance commissioner on charge of discrimination? None, that I can see. The fact that Jones is covered by a group policy, the premiums for which are paid by his employer, should not give Jones any advantage in rates for additional insurance over Brown.

It may be objected, of course, that the example stated is extreme, and would not occur in practice. Probably this is true, but anti-discrimination laws are hard to beat. Better to adopt practices and methods which cannot be criticized by even critical supervising officials than to court interference.

The other point to which Mr. Morris refers under Selection is that of insuring or re-insuring associations. As you are aware, fraternal benefit societies were originally opposed to group insurance on the ground that life insurance companies would insure the members of such societies, or re-insure the societies themselves, or certain of their lodges. This the companies very wisely do not do. The present agitation of the fraternalists is, however, more far-reaching. It has for its object the enactment of laws preventing life insurance companies from writing group insurance. I do not believe that this attitude is right, nor the position assumed tenable, nor do I believe that the objects sought can be obtained. At any rate, insurance companies should adhere strictly to the limits of the definition which I have already given, or to some other definition which they may mutually agree upon, and not branch out into a field of the enterprise which will antagonize other classes of insurers.

Premium Rates.

Under the above heading, the author gives a full and complete description of this important phase of group life insurance underwriting. I cannot, of course, add anything of importance, except possibly the following taken from my recent paper on "Life Insurance in Groups, 1912–1917," which will be of interest to you as bearing on the question of non-participating rates:

"In 1912, rates for group insurance, such as there were, were of necessity based upon the American Experience Table. In writing this class of insurance a low rate of expense exists. It soon became evident that rates for many of the younger ages, in the case of the less hazardous lives, considerably below the net premiums, according to the American Experience Table, could safely be charged. In other words, the American Table did not appear to be a satisfactory basis upon which to predicate premiums. The basic table adopted for comparative purposes by the Medico-Actuarial Committee of the Actuarial Society of America and the Medical Directors Association in their recent investigation, and based upon the later experience of life insurance companies, appeared to be satisfactory. This basis has accordingly been adopted by some of

the companies. I give below various rates at selected ages, which have been used by at least one insurance company in writing its group insurance. The rates numbered from 1 to 5 inclusive are used for different groups presenting different degrees of occupational hazards. For sake of comparison I give also the net one year term rate according to the American Table and 3½ per cent. interest. Across the columns I have drawn a line. All the rates above the line you will see are lower than the American net premium, whereas those below the line are higher.

Ages.	Amer. 3½%.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
25	$ 7.79	$ 6.01	$ 6.26	$ 6.76	$ 7.51	$ 8.51
35	8.65	6.41	6.66	7.16	7.91	8.91
45	10.79	9.17	9.42	9.92	10.67	11.67
46	11.17	9.75	10.00	10.50	11.25	12.25
47	11.60	10.38	10.63	11.13	11.88	12.88
48	12.08	11.07	11.32	11.82	12.57	13.57
49	12.67	11.87	12.12	12.62	13.37	14.37
50	13.31	12.76	13.01	13.51	14.26	15.26
51	14.05	13.81	14.06	14.56	15.31	16.31
52	14.87	14.97	15.22	15.72	16.47	17.47
53	15.78	16.20	16.45	16.95	17.70	18.70
54	16.80	17.48	17.73	18.23	18.98	19.98
55	17.94	18.87	19.12	19.62	20.37	21.37
65	38.77	45.88	46.13	46.63	47.38	48.38

"In the proposed rulings of one insurance commissioner, and I understand there are others of the same mind, a rate for group insurance lower than the net permium according to the prevailing standard is not to be permitted. This attitude I think is unfortunate. Any deficiencies in the premiums charged can be and should be taken care of in the reserve maintained. I will refer to this more fully later on. I firmly believe that the rates now in use are adequate. In any case, I am opposed to any legislation or rulings concerning them until it can be shown that they are inadequate. The present indications are that such a proof is not forthcoming. As long as the insurants are protected by adequate reserves, I believe that the companies should be allowed to continue to use their present rates."

As to the participating rates, I am afraid that I am too firm a believer in non-participating group insurance to discuss this question without prejudice. The participating rate contemplates only a one-rate schedule. Premiums are higher than the net premiums, and if experience warrants, the cost may be below the net premium in the final adjustment of dividends. This adjustment of dividends, of course, should be so made as to reflect the varying degrees of the hazards of the different employments insured and the different manufacturing processes in specific groups.

While I am discussing a phase of *life* insurance, I appreciate the force of the analogy between the underwriting of group insurance and certain casualty insurance lines. My feeling has always been that the rate on a group of employees as originally applied should reflect as far as possible the hazards covered as in the case of liability or workmen's compensation risks. I am aware that so long as life insurance companies write group insurance on the non-participating basis, and at the same time guarantee the rates in the contract for a series of years, they depart somewhat from the casualty features for this class of insurance inasmuch as rates on liability and workmen's compensation risks can usually be adjusted annually so as to reflect any change in the hazard insured.

There are two points referred to in the paper by Mr. Morris which should be emphasized. They both have to do with the casualty aspect of the subject. One is the question of service to the employer, and through him to the employee. While it is true that life insurance companies are to-day giving more service to their insured than formerly, nevertheless, insurance companies writing liability and workmen's compensation insurance have for a longer period than in the case of life companies found it advisable to give service. I have looked into the service offered by one life insurance company in connection with its group life insurance writings, and was surprised at what has already been accomplished by it, and the possibilities which the future offers in this respect.

The second point to be particularly emphasized is the translation of the rate charged into terms of the wage, or as Mr. Morris puts it, "The premium (once determined) is a function of the wage." All companies recognize this prinicple. The employer knows the amount of his pay-roll. What will the group insurance contemplated cost in terms of that pay-roll? Once that cost has been determined for the employer of a large progressive establishment in pay-roll units, the cost does not vary materially from year to year. I do not believe, however, that the time will come very soon when group life insurance rates will be calculated directly in pay-roll units.

Discussion of Certain Legal Features.

Under the above caption, the author discusses the very important subjects of the selection of a proper mortality table and the proper valuation of group insurance. Very little special legislation has been passed by the various states relating to group insurance. Such as there is appears in a summary at the end of this discussion for future reference.

Mr. Morris refers at length to the special deficiency reserve required by the laws of at least two states and the rulings of the insurance commissioners of other states, and says: "that a peculiar situation has come about whereby the insurance companies have

been obliged to put up deficiency reserves, although complying strictly with the valuation laws of the state."

I do not know whether or not this statement refers to the requirements of the insurance commissioner of the state of Connecticut. Assuming that it does, I do not quite agree with Mr. Morris from the standpoint of the legal requirements of our laws and rulings. The valuation law sets forth a standard. The law presupposes that the rates charged for insurances to be valued under this law are at least equal to the net premiums according to the legal standard. If such gross premiums are below the standard then the usual reserve on the legal standard is insufficient. I use the term "insufficient" in its legal sense, and not actuarially. The law in Connecticut does not deal with the adequacy of the rate, but rather sets forth the standard of valuation and an insurance company which charges premiums which are less than the net premiums according to the legal standard of valuation does not comply with the valuation laws of the state unless it also maintains an additional deficiency reserve equal to the present value of an annuity equivalent to the annual insufficiency of the rate charged.

Once this point is clearly established, I think there is something further to be said on this subject. In group insurance, it is the *group* that is the unit, not the individual employee covered by the group policy. In other words, we must divorce the idea of individual insurance from our minds, and deal with the group. That is what the employer thinks of; the insurer too, and also the underwriter, although due weight must be given to the individuals who compose the group. Why not follow the same idea in calculating the deficiency reserve? If the company is charged with a deficiency reserve why should not credit be allowed for such premiums as are above the adopted standard as an offset to the deficiency reserve? In investigating this problem, we have taken the position in valuing the group policies written by the Connecticut life insurance companies at rates below the American net that inasmuch as group insurance is still in the experimental stage, it is much safer to adhere to our rule. Theoretically, credit for excess premiums could be allowed but from the practical standpoint, I think it unwise at this time and during the period of development and experimentation to consider such a credit in the reserve calculations. I believe that the extra reserve as now required is larger than safety demands, but it is much better to be on the safe side. The companies have met the situation and are setting aside the extra reserve. This reserve at the end of 1916 was somewhat more than $300,000 and present indications are that the corresponding reserve at the end of 1917 will exceed $1,000,000.

If a group policy is but one policy why should we not, in calculating the extra reserve, determine first the net American premium for the entire group in the same way as a company determines the gross premium for the group, by combining the various

rates for all ages? This is but an extension of the previous problem. It seems to me that after a year or two more of group insurance, assuming that its development continues along present lines, it may be advisable even under our existing law to consider the blanket policy as a single contract, and for purposes of calculating the reserve ascertain the aggregate net premium corresponding to the aggregate gross annual premium charged in the case of each group. A comparison of these two premiums would immediately show whether the total gross premium was below or above the total net premium. If below then the difference could be treated as the deficiency and the extra reserve calculated in accordance with some average age method.

On page 168, Mr. Morris says: "The fundamental assumption upon which a deficiency reserve is required involves the question of sufficiency of rate." This appears as a part of the author's discussion of certain legal features. While I quite agree with him actuarially, and am willing to emphasize this point, nevertheless, from the legal aspect of the question, I cannot agree that the assumption upon which a deficiency reserve is required involves the question of the sufficiency of the rate. The fundamental assumption, it seems to me, is a legal assumption, the law of the state, or the ruling of the insurance commissioner, and not an actuarial assumption, as apparently set forth in this connection. Mr. Morris points out very clearly and accurately the absurdities into which we are led by requiring deficiency reserves for group insurance issued at rates below the net legal minimum standard. I agree thoroughly with him on purely actuarial grounds.

I also agree with Mr. Morris when he emphasizes the necessity of a proper mortality table as a legal basis for reserve valuation. I cannot refrain, however, in closing this discussion, from saying what I said to the National Convention of Insurance Commissioners in St. Paul last August, namely: "As to the need for legislation, I have tried to show throughout this discussion my attitude. I believe group insurance is established; that it is being written along proper safe lines and that it is meeting a legitimate demand. Do not limit or hamper the development of group insurance by legislation or by rulings if you can reasonably avoid doing so. Let it develop along natural lines. I am fully aware that you may not all agree with me." You all know that the insurance commissioners did not agree with me unanimously, but rather appointed a committee to investigate the subject.

Summary of Laws Relating to Group Insurance.

Arizona.

Any life insurance company may give special rates to members of organizations or to employees in groups of not less than one hundred. Section 3449, Civil Code of 1913.

Florida.

Nothing in this section shall be so construed as . . . to prohibit any life insurance company doing business in this state from issuing policies of life or endowment insurance with or without annuities at rates less than the usual rates of premiums for such policies insuring employees of any employer who through their secretary or employer take out insurance in groups of not less than fifty persons and pay their premiums through such secretary or employer." P. 110–111, Session Laws 1915.

Idaho.

Any life insurance company may issue life or endowment insurance at less than usual rates to groups in organizations, not less than fifty, for insurance taken out through secretary or employer. Chapter 97, Laws of 1913.

Iowa.

Under Section 1783-*b*, Supplemental Supplement Code 1915, Commissioner has ruled that "a policy covering group life insurance could not be approved, unless there be attached to the same a copy of the application, which shall embrace a satisfactory medical examination." Insurance Commissioner's letter, May 11, 1916.

Maine.

Nothing in this section shall be so construed as . . . to prohibit any life insurance company doing business in this state from issuing policies of life or endowment insurance with or without annuities at rates less than the usual rates of premiums for such policies insuring members of organizations or employees of any employer who through their secretary or employer may take out insurance in an aggregate of not less than fifty members and pay their premiums through such secretary or employer. Chapter 84, Laws of 1913.

Massachusetts.

Section 71. No life insurance company organized under the laws of or doing business in this commonwealth shall enter into any contract of insurance upon lives within this commonwealth without having previously made or caused to be made a prescribed medical examination of the insured by a registered medical practitioner; except that an inspection by a competent person of a group of employees whose lives are to be insured and their environment may be substituted for such medical examination in cases where the insurance is granted under a single policy issued to a given person, firm or corporation, covering simultaneously a group of not less than one hundred lives all in the employ of such person, firm or corporation.

Minnesota.

Any company may issue industrial policies of life or endowment insurance with special rates to members of lodges or employees of one employer for insurance taken out through secretary or employer, not less than fifty in number. Section 450, Pamphlet 1915.

Nebraska.

No life insurance company shall make or permit any distinction or discrimination . . . except that any life insurance company doing business in this state may issue policies of life or endowment insurance with or without annuities on the industrial plan with special rates of premiums (but without discrimination) less than the usual rates of premiums for such policies when issued to members of labor organizations. societies or similar organizations, or employees of one employer, who through their secretary or employer may take out insurance in an aggregate of not less than one hundred members and pay their premiums through such secretary or employer. Provided, however, that nothing herein contained in this section shall be construed to permit the entry into any contract of life insurance upon groups taken from any fraternal beneficiary society doing business in this state. P. 85, Insurance Pamphlet 1913.

New Hampshire.

"Any life insurance company doing business in state may issue life or endowment insurance at less than usual rates to groups in organizations, not less than fifty, for insurance taken out through secretary or employer." Chapter 127, Laws of 1913.

New Jersey.

No life insurance company doing business in this state shall make or permit any distinction or discrimination . . . except that any life insurance company doing business in this state may issue policies of life or endowment insurance with or without annuities on the industrial plan, with special rates of premiums less than the usual rates of premiums for such policies to members of labor organizations, lodges, beneficial societies or similar organizations, or employees of one employer, who through their secretary or employer may take out insurance in an aggregate of not less than one hundred members, and pay their premiums through such secretary or employer. P. 84, Insurance Pamphlet 1916.

New York.

Section 96 (as amended—1916, 1917).

Limitation of New Business.

. . . provided, that in determining the amount of new business issued, policies of reinsurance, group insurance granted on the same plan within each group, under a contract with a given person, firm or corporation, covering groups of not less than one hundred lives all in the employ of such person, firm or corporation, industrial policies issued upon the weekly premium plan, policies known as intermediate policies issued by corporations transacting the business of industrial insurance, and policies which by reason of residence, occupation, or personal or family history or impaired health, call for the payment of higher premiums than those charged for standard risks, and all premiums on such policies and the expenses in connection with such policies, shall be excluded. . . .

Texas.

Policy may be issued on groups without medical examination of individuals and may be continued on individuals after ceasing to be members of group without violating the Anti-Discrimination Laws. Opinion of Attorney General dated June 30, 1915.

West Virginia.

Section 15. (Amended 1913.) Nothing in this section shall be so construed . . . to prohibit any life insurance company doing business in this state from issuing policies of life or endowment insurance with or without annuities at rates less than the usual rates of premiums for such policies, insuring members of organizations or employees of any employer who through their secretary or employer may take out insurance in an aggregate of not less than fifty members and pay their premiums through such secretary or employer.

MR. EDMUND E. CAMMACK:

The members of the Society are indebted to Mr. Morris for bringing to their attention a comparatively new development in the field of insurance. The importance of the subject will be recognized from a survey of the growth of group insurance since its inception five years ago. In the following table estimates of the amounts of business in force and the number of lives insured at the end of each of the preceding five years and at the end of June of this year are given.

In Force.	Number of Employees.	Amount of Insurance.
Dec. 31, 1912	11,450	$ 13,083,000
" " 1913	30,125	28,235,000
" " 1914	52,625	50,605,000
" " 1915	105,000	83,920,000
" " 1916	202,000	155,300,000
June 30, 1917	325,000	250,000,000

This table is taken from a paper read by Mr. H. Pierson Hammond at a meeting of the National Convention of Insurance Commissioners held at St. Paul, Minn., last August. There are probably to-day, counting the families of those insured, over a million people directly interested in group insurance.

There is a close analogy between compensation insurance and group insurance. Compensation insurance provides indemnity to a workman in the event of disability arising from occupational accident and to his dependents in the event of occupational accidental death. Group insurance provides indemnity in the event of disability or death in active employment from any cause. With the continued centralization of industrial activities in large plants employing large bodies of workers, the personal relations that used to exist between employer and employees have to a great extent vanished. Nevertheless, the employer is coming to recognize that obligations to his employees beyond the payment of wages have not ceased. Group life insurance removes from the employer any further moral obligation to provide on the death of an employee for his dependents. Moreover, it is probable that the cost of group insurance is more than offset by the benefits resulting from increased stability of labor. Insurance increasing with term of service is undoubtedly an inducement to an employee not to change from one position to another unless there are substantial reasons for doing so in the shape of higher pay or shorter hours.

Mr. Morris's description of the usual terms and conditions of a group contract, together with his discussion of the basis of premium rates will be useful to any company contemplating embarking upon this class of business. It is to be inferred from what he states that if premiums are to be paid otherwise than annually, that is, semi-annually, quarterly or monthly, the policy contract should provide for deduction from the claim of the unpaid premium installments for the current policy year. What the employer wants is insurance by a fixed schedule on each life without deduction and, in my opinion, the policy should provide for payment of claims in full. Semi-annual, quarterly and monthly premiums should be true semi-annual, quarterly and monthly premiums and should provide for payment of the full sum insured without any deduction whatever.

Mr. Morris states that frequently a request is received that the employees be allowed to purchase additional insurance equal to the amount of insurance furnished by the employer. A provision in the policy allowing such optional additional insurance would seem to me to be unsound. I do not believe that the danger is eliminated by the requirement of a medical examination, because the persons taking out the additional insurance cannot be bound to continue it during employment but can and probably will in years to come, when they find their premiums mounting up, exercise selection against the company. In my opinion, insurance on

the one-year-renewable-term plan is not suitable for the industrial classes, where the premium is paid by the individual. I believe that such insurance can only lead to dissatisfaction in the end and that it should be discouraged.

Several companies writing group insurance upon the non-participating plan use rates based upon the Medico-Actuarial Mortality Table with three and one half per cent. interest, with a loading of forty cents per $1000 of insurance and seventeen per cent. of the gross premium. An extra charge is made by addition of a constant at all ages for industrial groups not considered first class risks. It is usual to apply the same rate to all persons in a group even though it may involve several classes of occupation with clearly varying hazards. The aim of the underwriter is to determine a rate which though admittedly inadequate for the more hazardous classes of occupation shall be sufficient when applied to the whole group. In this way the complications attendant to charging varying rates for different classes of occupation in one group as is done in compensation insurance are obviated. In my opinion, refinement in classification should be avoided.

Mr. Morris has suggested that possibly group insurance might be handled in a way similar to that in which the casualty companies transact compensation business. The idea is that premiums could be based upon payroll so as to eliminate the perpetual census record of employees that the companies now keep as a basis of cost. If legal enactment were obtained to enable companies to write business in this way, I doubt whether there would be any resulting advantages.

The basis of insurance for a group policy is usually either annual wages, term of service or flat amount. It is true that when the insurance is based upon annual wages the rate could be approximately computed as in compensation insurance by an audit of the payroll after a census of the employees had been taken. The determination of an equitable rate would necessitate this census, which, however, would not have to be repeated for a considerable term of years. Some modification of the method would have to be adopted when the basis of insurance was other than annual wages. It is my opinion that no economy would be effected in this change. I believe that the cost of audits and periodic censuses would outbalance the cost of keeping a perpetual census of employees. This latter is now done by the employer advising the insuring company immediately he engages or discharges an employee.

Group contracts differ from compensation policies in one respect that should be emphasized. They are non-cancellable and written usually at basic rates guaranteed against increase for terms of years, so far as I know, from five to twenty. The clause in the group policy which allows the employer to continue the insurance upon the life of an employee after his employment has ceased, whether it extends this privilege only to cases in which termination

of employment has resulted from sickness or not, is likely to be such an important factor in the ultimate cost of insuring the group that I think especial attention should be directed to it. When issuing a group policy it is usual to insure only the lives of employees working on full time. Naturally, these lives constitute at the outset a select body. After the lapse of a short time, however, it will probably be found that the employer is carrying insurance upon a good number of men whom he has taken off his payroll, because they have had to stop work temporarily owing to sickness. The body of lives will no longer be a select one. In the first few months of the policy it is probable that the employer will not fully appreciate the privileges of his contract and he will terminate the insurance on a good many employees who have left him on account of ill health but the cause of whose leaving he did not know. After a little experience the employer will take steps to find out the reasons why employees leave him so that he may keep insurance in force on those who have stopped work on account of ill health. I have come to this conclusion from the actual experience of the company with which I am connected. This company has, in fact, paid claims on insurances that have been terminated upon receiving assurance from the employer that employment ceased solely from sickness and that request for cancellation was made under a misapprehension. Furthermore, the experience of the Aetna Life Insurance Co. in its group department shows that the ratio of actual to expected deaths by the Medico-Actuarial Mortality Table increases from the calendar year in which business is issued to the next calendar year nearly fifty per cent. From the experience of several companies the Medico-Actuarial Mortality Table appears to show a decided weakness around age fifty. It is probable, however, that this weakness is largely accounted for by misstatements of age. A workman over fifty years of age is very liable, in seeking employment, to understate his age from the fear that knowledge of his actual age may count against him in securing a position. Evidence of this is shown by the fact that understatements of age at the older ages frequently appear in the settlement of death claims. The only way that a company can protect itself is by charging rates high enough at these ages to cover misstatements. It is not practicable to reduce the sum insured to the amount that the actual premium paid would have purchased at the correct age, because the employer wishes insurance for stated amounts and requires payments of claims in full regardless of technicalities.

Most of the exposure in group business has been in a time of remarkable business activity, accompanied by extraordinary expansion of industrial plants. The question arises as to whether the mortality to be experienced will be affected by periods of depression when the turn-over of labor is greatly reduced.

Mr. Morris states that the mortality experience under group policies has up to now been surprisingly low, but I question whether

there is sufficient evidence to warrant the opinion that it will compare favorably with that under medically examined lives applying for individual policies even when only cases are considered in which the whole of the premium is paid by the employer. While it is apparent that rates computed by the American Experience Table of Mortality with a nominal uniform loading for expenses are entirely unjustifiable, such rates being excessive at the younger ages and dangerously low at the older ages, I am of the opinion that early and immature experience should be used only as a guide for the future and, as a basis of premium rates for long term contracts, with considerable caution.

MR. WILLIAM J. GRAHAM:

Mr. Morris has ably sketched "Group Insurance and Its Possible Development" in his comprehensive paper. Viewed from a life insurance company's point alone, group life insurance is a biggish topic. In its immediate objective of insuring the pay envelope, it goes deeply into problems of the industrial world and ramifies into fields of sociology and economics. When one attaches to this subject, as Mr. Morris has done, a sketch of the possible development of group insurance, the topic grows to such proportion that the lengthy paper of Mr. Morris becomes in itself a bare synopsis. Mr. Morris recognized this when he restricts himself more particularly to the subject of "Group Insurance and Its Possible Development" from an underwriter's viewpoint. It would be a work of supererogation to go through Mr. Morris's entire paper to comment categorically upon the different topics which he has listed. Each subtopic might be much enlarged, but Mr. Morris has wisely held to first principles. Before making a few comments on the broader phases of group insurance and its purposes and possibilities, I will restrict myself to comment on those relatively few places in Mr. Morris's paper, where I think a word of supplement or a divergent opinion is in order.

First, as to the historic reference. Broadly viewed, all life insurance is group insurance, since it is patently impossible to apply insurance principles to an individual except as that individual is made a part of a group. Among the first policies issued by the New England Mutual Life Insurance Company, which was the first American life insurance company to obtain a life insurance charter, was a group insurance contract. This contract was issued on the lives of 700 coolies under one policy issued to indemnify the shipper transporting these coolies from China to Panama in event of the death of the coolies. The policy was taken out for $15 on each coolie, but the amount was afterward changed to fourteen and seven-twelfths dollars each in order to include twenty additional coolies without increasing the total amount of risk. The Manhattan Life Insurance Company,

which at that time was just commencing business, carried a similar risk on these coolies. This unique contract recited that the policy would continue in force until twenty-four hours after the ship *Seawitch,* which was transporting the coolies, had successfully completed the journey from China to its destination in the harbor in Panama. To the inquirer concerned with the niceties of classification this risk might appear to be quite as much so some other form of insurance as life insurance, which serves to accentuate the experimental trend and uncertain scope of the business in its earlier day.

The Equitable Life Assurance Society issued, in February, 1905, a policy covering the lives of the employees of the United Cigar Stores Company on the one-year-renewable-term plan, requiring, however, a form of medical examination for this insurance. During the latter part of 1911 two group insurance policies were issued without medical examination on the yearly-renewable-term plan. The Montgomery Ward & Company group policy was issued July 1, 1912. Unquestionably, the inquiry of Montgomery Ward & Company and in particular the brilliant and indefatigable work of the attorney of that company, George R. Durgan, upon plans for employees' health, accident, life and pension benefits, over a period of some two years prior to the actual issuance of the Montgomery Ward & Company contract, had much to do with stimulating and formulating of the group idea.

The only issue that I would seriously raise with Mr. Morris is with reference to his statement on the subject of premium standards. Life insurance differs radically from casualty insurance, insomuch as the individual age is a determinant of the premium. The reasons for this in individual insurance are obvious, insomuch as the age measures the increasing hazards to life. Group life insurance is but the application collectively of a form of individual life insurance sanctioned by the various life insurance statutes. The American Experience Mortality Table has been adopted as the statutory standard in most of the states of the Union. In the aggregate it overstates the aggregate mortality of the American life insurance companies by about 30 per cent. of the tabular rate. This overstatement is not uniform at the various ages, being widely divergent, in fact, between the early ages, the middle ages and the older ages. But in the aggregate, for the companies reporting to the state of Connecticut, it produces a mortality ratio of about 70 per cent. of actual deaths to the full number of deaths to be expected from the table. Group insurance is too new and experimental as yet to reach positive conclusions with respect to the mortality. Yet I believe that, in the aggregate, group insurance mortality, to date, will be found to approximate the ratio of actual to expected loss experienced on the regular business.

It would appear, therefore, that the question of adopting a standard of mortality that would more faithfully represent the actual

mortality than does the American Experience Table of Mortality is not a problem limited to group insurance but is more properly to be viewed with relationship to the whole life insurance business. Advocacy of such new table is not new, and has for some years been made the cause of study and investigation by both the Insurance Commissioners and the Actuarial Society with the result that at this time the Actuarial Society has in preparation a new mortality table. Contributions of data from various leading companies represented in the membership of the Actuarial Society of America covering the experience of these companies (on policies with anniversaries from 1900 to 1915) are now in work, under the direction of a special committee, to produce a new table more faithful to actual experience than is the American Experience Table. So far, therefore, as aggregate experience is concerned group insurance has not uncovered any new faults in the American Experience Table.

Again it seems to me that any variation of group insurance from the mortality standard between the different ages is of less importance that the same variation in individual insurance. Mr. Morris points out that the mortality rate in group insurance at the younger ages in much under the American Experience Table and more closely approximates the Medico-Actuarial Table. A variation of this kind, compensated for by a relatively higher mortality at the older ages, leavens itself in the group, whereas it may become a matter of injustice in individual insurance. The lower mortality on the young is compensated by the higher mortality on the older lives, when totaled together and paid for, as is usual, in the group insurance by the employer in one sum. In individual insurance, however, a failure of the mortality to approximately express the rate at any age period may work injustice to the individual premium payer.

The question of lower mortality standard does not necessarily mean the question of lower premium rate. Mr. Morris refers to this when he states that "in using the M.-A. table, however, as a basis for mortality rates it is necessary in building up the premium to provide for ample loading not only for expenses but also for profits or other contingencies." The question of lower rates to the patron and even lower legal reserves is not necessarily involved in question of lower mortality table following more faithfully the experience curve. Naturally, the mutual plan of higher premiums, adjusted later by premium refunds based on experience, has advantages in smoothing out inequalities in mortality tables not present in non-participating rates. But even here it is possible—and indeed would be but following the precedent fixed by large non-participating companies in the field of industrial insurance—for the non-participating company to return more or less gratuitously any unneeded premium excess after experience has established the fact and the amount of any such excess to the patron.

I am not at this time debating the question as to the need or advisability of adopting for group insurance a table which will more

accurately represent group mortality than does the American Experience Table, but I would point out that it has not been shown that the American Experience Table is any more faulty with reference to group insurance than it is with reference to faithfully reproducing the mortality on individual insurance. Why therefore, abandon it for group?

And here should we not give thought to the departure we would thus attempt in our net premium system or at least in the way we have had of following the statutory net premium as a minimum gross premium. Old-line life insurance has grown strong and prospered in America by means of the net premium system and the net premium valuation. Under this system, we set up a standard of mortality and interest planned to serve as an irreducible minimum for fixing our premium valuations, and thus legally presuppose a gross premium of not less than the statutory net premium. We have changed the standards from time to time by statutory means; and it seems to me that we should go slow in introducing any lower standard of premium without statutory permission. If the American Experience Mortality Table, now commonly used as a standard in the various states, is not right for fixing premium rates either for group insurance or other insurances, let us have a new standard, but let it come fully sponsored by law.

Group insurance is transacted under the laws that govern legal reserve life insurance, an for such reason, no statutory permission has been required in the different states to do group insurance, although a few states have adopted amendments to existing laws to facilitate and promote the issuance of group insurance. If, under such circumstances, it is permissible to use the Medico-Actuarial table, which is lower than the state standard of mortality, it is permissible to use any other table. And here we produce the anomaly of old-line life insurance getting away from the general principle of a minimum premium implied by the net premium of the legally established table just when fraternal bodies, after disastrous experiences brought on by lack of a statutory minimum net premium, are called upon by new laws to have such an irreducible net premium in the National Fraternal Congress Table of Mortality.

It is to be noted that since Mr. Morris wrote his paper, the insurance commissioners of the various states have adopted the following resolution:

"*Resolved,* that a committee representing the convention and composed of six to be selected by the President be requested to make an investigation and to report to the convention such standards for conducting the business of group life insurance as in their judgment are necessary for its prudent operation and that the Convention invite the Actuarial Society of America to select six actuaries representing the Life companies to co-operate with this committee

in the investigation, and report to the end that results may be reached which will inspire confidence and general acceptance."

Pursuant to this resolution, a committee of six insurance commissioners has been appointed. A committee of six members of the Actuarial Society of America has also been appointed to confer with these insurance commissioners, as requested. This will probably serve to bring up the subject as to new laws or rulings to be adopted governing group insurance. The appointment of this committee followed the criticisms of certain insurance commissioners as to the departures in group insurance underwriting which they did not consider to be warranted as sound underwriting, but upon which the laws of the state were not sufficiently specific.

These points are well illustrated in a tentative set of rulings issued by Insurance Commissioner Cleary of Wisconsin but now held in abeyance pending the action of the Insurance Commissioners' Committee. These rules are as follows:

"Policies of Group Insurance may be issued in this state subject, however, to the following restrictions:

"1. Benefits under a group policy shall be payable to a beneficiary designated by the employee.

"2. Each group policy shall cover not less than one hundred (100) lives when medical examination is waived.

"3. Lives covered by the policy must be in the employ of a single employer. Selection within the group will not be permitted.

"4. No group policy shall be issued for the purpose of promoting the sale or use of any commodity, or as an inducement to individuals to patronize or deal with any business enterprise or institution.

"5. The group policy shall provide for the issuance of an individual policy to an employee who is for any cause eliminated from the group. This policy shall be issued without medical examination, with a premium rate based upon the attained age of the assured; provided application therefor is made within thirty days after notice from the insurance company that such employee has been eliminated from the group policy, with a statement that he has the right to an individual policy without medical examination. Such individual policy shall, at the option of the individual, be one of the ordinary forms of insurance issued by the company.

"6. The premium charged shall be equal to the net premium for the kind of insurance provided, computed on the American Experience Table of Mortality with interest not exceeding three and one-half per centum.

"7. This ruling, except as to the premium and the medical examination, shall also apply to group accident insurance policies."

Without debating the merits of these specific rulings and the limitations set forth in them, it would appear that all regulations and restrictions necessary or desirable for group insurance could be achieved by a system of rulings of this kind, supported, when

necessary, by statutory amendment, and that no particular code for group insurance, as a separate department of life underwriting, need be adopted. The attempt to clarify group insurance by legislative action has, in the one state in which such attempt was made, caused group insurance to be attacked by advocates of fraternal assessment insurance. These organizations wrongfully assumed that group insurance was meant as a menace to their associations and the objections urged against it were specious and untrue. Nonetheless, carried out as a pure political propaganda, they add to the difficulties of getting intelligent legislative action on the subject.

Mr. H. Pierson Hammond, actuary of the Insurance Department of the State of Connecticut, in an able paper on the subject of group insurance delivered before the Insurance Commissioners' Convention, illustrates the growth and development of group insurance in the following table:

In Force.	Number of Employees.	Amount of Insurance.
Dec. 31, 1912	11,450	$13,083,000
Dec. 31, 1913	30,125	28,235,000
Dec. 31, 1914	52,625	50,605,000
Dec. 31, 1915	105,000	83,920,000
Dec. 31, 1916	202,000	155,300,000
June 30, 1917	325,000	250,000,000

These figures are highly suggestive when taken in connection with Mr. Morris's statement that at the present time it is doubtful whether over a thousand group contracts have been written in the United States out of the hundreds of thousands of employers who might be interested.

We are learning as a nation that it pays to take care of the human unit—to conserve this unit in life, limb, efficiency and freedom from worry. Our problem, as a democracy, is to achieve this without interfering unduly or unnecessarily in any respect with the individualistic principles upon which our political life is planned.

Group insurance points a way for making life insurance as universal as the pay check.

Every life having an earning capacity creates need for life insurance. Life insurance as individually issued failed, and must fail, to reach all because of its methods of individual selection, entailing as it does rejections for medical, occupational and moral hazards, its establishment of age limits, and, more than all, the method of propaganda by which the business depends upon individual agency solicitation. Group life insurance averages the weak with the strong and insures all, making the sole criterion of acceptability "active service," or being regularly on the payroll of the employer. The employer pays the premium and the consideration is better service from the employee. That this consideration

is real and substantial to the employer is well attested. The employee, therefore, pays for his insurance in coin of better industrial relationship with the employer; and the employer is paid in full. This is a sound basis, consonant with American ideals. It points the way for a further expansion of industrial activities to assist the employee along other directions, such as pensioning, disability benefits and institutional care of health and physical comforts. And it may be restated that all these benefits are part of the Montgomery Ward & Company plan, referred to by Mr. Morris, though only the life insurance has been worked out to the point of reinsuring with an established insurance company.

While, as Mr. Morris pointed out, something of these other benefits might be achieved by use of group policies on other than the term plan, I do not believe that the expansion of group life insurance along such lines will materially assist in these other directions. Group insurance is on the yearly-renewable-term plan because the yearly-term plan is practically an unvarying premium plan when applied to insuring all employees of a going concern. Of course, the premiums on each life vary yearly with the increasing age. But in the aggregate, the age distribution will, with the changes occurring in the personnel, remain on the whole about the same. Therefore, the yearly-renewable-term-plan premium represents to the employer a premium which may vary in either direction of increase or decrease, but within such narrow limits, under ordinary circumstances, that the premium as a whole is practically unvarying. This is pure death benefit at minimum cost. It covers the one hazard of indemnity to the beneficiary for loss of life arising from death through any cause, inclusive of long illness while in the service of the employer. If it is desired to add to the death benefit a provision against old age, I am inclined to think that the logical way to do this is in disassociation with the group life policy.

Pension plans, pension policies, annuities, pension funds—all represent practical ways in which the old age question could be treated as one entirely apart from the death benefit. A logical combination of insurance and old-age provision covering the needs of workers is made by combining group insurance as term insurance over the working period, with some system of service annuities to begin at fixed superannuation age or previous disability. This means insuring the pay check during the term of its receipt and treating the old-age problem in a separate subdivision or as a separate item in the larger category of means to relieve financial distress to the employee.

Group insurance on the term plan, when improved by addition of service pensions, intelligently covers the purpose to be served; to wit, life insurance protection on the term insurance plan while at work, to all the workers, and superannuation annuities at the retiring age for the relatively few who persist in the employment

until they reach the retiring age. This subject of superannuation pensions I will not attempt to treat here other than to point out the fact that there would be an enormous loss to the employer who attempted to cover the same by means of long-term endowment insurance under the conditions of high labor turnover which obtain now in industry.

We now have workmen's compensation insurance, doing a splendid work, which would have been considered socialistic and revolutionary twenty-five years ago. Compensation insurance is a matter of legal justice, while group life insurance is a gratuity, yet, like group insurance, it pays, because it means juster relationship between employer and employee; and I would question whether a substantial minority could be found now among the responsible employers of the country to favor abolishing compensation insurance, even if assured relief from the claims of injured workmen and heirs of the killed workmen. Supplementing compensation insurance, group health and accident insurance, covering other than working hours and classes of diseases not reached by compensation, is, I prophesy, a plan of future development, already presaged by a few such groups now in force. The underwriting difficulties here are much greater than in the adoption and application of group life insurance. Under group health and accident insurance it is necessary to achieve the benefits without haggling with the employees and yet without permitting the employees to malinger. The adjustment of such claims, when handled by the insuring company, presents difficulties on the one hand through friction in too-critical settlements, and, on the other hand, through leniency which would create dishonest claims and consequently promote loss of time and loss of efficiency to militate against other benefits of the insurance. Nonetheless, there is a real field for removing distress along this line. The success of group life insurance indicates the likelihood of this field being adequately investigated and adequately covered. Here, however, chiefly because of the difficulties incident to claim adjustments, the employer will have more reason for considering handling such benefits himself or through a mutual benefit organization than would exist in the case of group life insurance.

Mr. Morris has pointed out reasons which move the employer to insure the group life risk rather than attempt to carry it himself. At that, I believe Mr. Morris has omitted one of the strongest business reasons for an employer's insuring the risk, which is, that by so doing he can place in the hands of each employee an insurance certificate which gives his beneficiary a direct claim upon a responsible life insurance company for the amount of the insurance. While the employer might be abundantly able to carry out any such contract, the practical situation is that the employer is giving this certificate to the living employee, written in his name and that of his beneficiary, is doing him an immediate service. The life

insurance company is, therefore, in position to co-operate with the employer to the extent of visibly benefiting each man in the establishment to the tangible possession of an insurance policy; whereas, under the other system, the benefits are more likely to be considered as restricted to the particular beneficiaries of the relatively few who die.

In conclusion, would state that we are all indebted to Mr. Morris for his painstaking analysis of the underwriting phases of group insurance. Behind this paper of Mr. Morris go years of experience, research, and, as he states with reference to the companies doing this business, "a great deal of time spent on problems that pertain to this subject, time very poorly spent if premium returns were considered." But I know Mr. Morris has not considered his time in this matter. He has given cheerfully, and it would be my particular suggestion to the fertile minds in this Society, dealing as they do with insurance in many forms, that problems presented in the course of our daily work may well be viewed entirely apart from the premium return and with reference to opportunities for service. I feel strongly that the insurance men of this country, and more particularly the actuaries, and, I might add, still more particularly the casualty actuaries, have before them enormous opportunities for devising ways and means of relieving distress through insurance principles in the various forms in which it is possible to relieve such distress from the indidual and distribute it among the group. The future is going to know less and less of the wide class divergence which we know today, and is going to bring more and more into our national life the better care of all classes of people. The well-to-do can care for themselves. But the suffering which now comes to the poorer classes through the absence of insurance of the various kinds which we can fancy, through the absence of better medical care, of medicines, of adequate nursing, of hospital service, good air, hygiene, sanitation, decent living places, yea, and playing places, are things which we must correct. And in that correction, along individualistic lines, lies the perpetuation of American standards of individual liberty and democratic government consistent with the imperative necessity of removing in the name of liberty unlimited liberty to the poor, the weak, the thoughtless, to suffer and endure.

MR. RICHARD BRODIN:

The subject has been so well covered in this paper and every phase of the same so thoroughly discussed by the author, that after going through the paper several times, I do not find anything of value to add, in my discussion of the same. There are, however, one or two points which I should like to take up, one of which is the question of plan.

The author discusses only the one-year renewable-term plan, and the ordinary life plan, eliminating the ordinary life plan on account of its higher cost, and its requirement of individual contracts; when he considers only these two plans, there is, of course, everything in favor of the one-year renewable-term contract.

I think that the author should have given us his opinion of the contract on the five- or ten-year renewable-term plan. The premiums on these latter plans are only a very little higher than on the former, and a contract of this kind gives the insurer more stability and continuance in his group-insurance business, the premiums being slightly higher at the beginning of the period than on the one-year term plan, and remaining the same for the respective five- or ten-year period. Compared with the premiums on the one-year term contract, they will gradually be smaller during the last years of the period, for the same number of employees.

The employer will also know exactly what he must pay during the period covered by the contract, and when the contract is renewed for another term, the readjustment of the premiums based on the five-year increased age, will cause the employer to engage younger help as much as possible.

A group-insurance contract on the five- or ten-year term plan, also works in the interest of the company, because if the policy should lapse during the early years of the period, on account of non-payment of premium, the company will be somewhat reimbursed for its initial expense, by the reserve.

Premium Rates.—The rate-making problem solves itself, in finding a basis on which to calculate a basic net premium covering a non-hazardous mortality. For this purpose, the M.-A. Table is not to be recommended, as the same is based on the experience of insured lives with medical examination.

It appears to me that the United States Life Tables of 1910, issued by the Bureau of the Census, could give us a table of mortality as close to the actual expected as can be desired. This table is a population table showing a slightly higher mortality than the M.-A. Table, which in my opinion is quite right, on account of the selection resulting from the medical examination which can not be altogether eliminated by taking away the mortality during the first five years of insurance.

The table I refer to is "Life Table for White Males in Cities of the Original Registration States." The same is ungraduated, and to be useful for our purpose needs to undergo a smoothing-out process. The reasons for my recommending this table are self-evident.

After the basic net premium is found it is a matter of underwriting ability to determine the differentials to be applied in order to obtain gross premiums of the "Group" to be insured. I believe that a study of workmen compensation rating is very valuable in this regard.

The foregoing discussion is not adding much of value to the paper and must be viewed in the spirit of "doing my bit" as a member of the Society.

MR. EDWARD B. MORRIS:

(AUTHOR'S REVIEW OF DISCUSSIONS.)

The author's principal intention in presenting this paper was the introduction of a subject of considerable importance on which there was comparatively little literature, although the subject involved perhaps one of the most radical advances in life insurance development in recent years. Although the paper as presented was a long one as compared with the usual contributions to the Society, it really only touched upon its outline. The possible development of insurance by groups really deserves months of continuous study. Life insurance when applied to the insuring of individuals through the issuance of individual contracts has settled itself into a known science, by which I mean that there are no radical changes involved from year to year. Its reconstruction means the redevelopment of older practices. The corresponding situation as involved in the insuring of lives by groups is today a very different proposition owing to the newness of the business. While the issuance of group insurance on employees by means of the one-year renewable term policy is in itself a simple matter, in theory at least it involves especially in its underwriting feature fertile fields of investigation which are hardly suggested in individual life insurance. As Mr. Graham has pointed out, since the paper was presented the insurance commissioners have become interested in group insurance and interesting discussions of the subject are now under way under their guidance. While the endeavors of this committee will undoubtedly be to conserve rather than to construct, the whole subject is today in a period of transformation.

The result has been that the comments upon the author's original paper have been almost as voluminous as the paper itself. Those who have discussed the paper have been members personally interested in the development of this business. The Society is therefore to be congratulated upon the character of the discussion.

Perhaps the principal point which has been mentioned has been regarding the proper basis for group rates. This is particularly of interest as the subject has been discussed from the two points of view—that is, from the participating and from the non-participating—and a perusal of these pages will show some of the fundamental differences that exist. I shall make no endeavor to here discuss this matter further than to state that the subject is necessarily an important one and is undoubtedly heading towards a satisfactory conclusion. The proper basis of rates is, of course, dependent upon the experience of the companies writing the business. As has

already been stated from various sources, this experience is far from complete inasmuch as the business is comparatively new. The companies writing the business have gained many important facts but these pertain more to the tendency of the final result than to the final result itself. It is my conclusion that it is safer to let the companies work out their own salvation, correcting any mistakes which have been made, in an endeavor to put the business on a stable basis. In the author's opinion it would be wrong to hamper the development of the business, for instance, by destructive legislation. The companies which are involved in the business are practically all of sufficient size to stand some shock but inasmuch as the development of the business necessarily tends towards a leveling of ideas (for it must not be forgotten that no company is desirous of writing the business at a loss either to stockholders or to policyholders) the general progress is favorable. Underwriting principles will be gradually established; contract conditions must gradually become uniform and I venture to state that the cost of group insurance in the various companies spread over a satisfactory period will closely approximate itself regardless of company or regardless of the various methods upon which the companies proceed.

As has been ably pointed out, there is a vast chance for development in the service pension benefits, that is, in the actual return to the employee for long service in the way of an annuity. There has not been considerable accomplished yet along these lines and consequently a tremendous field is open.

In conclusion, I wish to thank the members of the Society for their attention to this subject and especially those members who have so ably contributed towards its discussion.

REVISION OF WORKMEN'S COMPENSATION RATES (JANUARY–MARCH, 1917)—HARWOOD E. RYAN.

VOL. III, PAGE 175.

WRITTEN DISCUSSION.

MR. RALPH H. BLANCHARD:

The divergence between financial exigency and scientific thought is well illustrated in the chief controversy of the recent rate revision over the use of graduated reduction factors, law differentials and expense loadings. The immediate cause for revision was the necessity for an advance in rates to provide adequate income for the carriers. The application of a flat percentage increase to all rates would have been the simplest means of accomplishing this end. But the demand for justice to individual classifications precluded any such aggregate method of procedure. So law differentials were revised, the experience of individual classifications and groups of classifications was considered, and a rough graduation of expense loading by states was retained. While the procedure and the results are a real improvement over those of the 1915 conference, they are still marked by the desire for action rather than accuracy and by an easy tolerance of assumptions and approximations which produce sufficient income.

This criticism is not intended to imply that thoroughgoing scientific accuracy was possible. The necessity for immediate advance in rates was properly controlling. The graduation of reduction factors and of law differentials presented problems of statistical research which required considerable time for solution. Nor was there complete agreement on the basis of such graduation among its advocates.

The recognition of the principle by the actuarial committee and the adoption of a resolution calling for further actuarial and statistical study are forward steps. They are evidence of a growing purpose to begin preparation for further rate revision sufficiently in advance to preclude the familiar explanation that changes proposed in the interest of actuarially sound rate-making were admirable but that practical necessity and a lack of time prevented their adoption.

Less defensible, it would seem, was the refusal to adopt a graduated expense loading. The flat loading used in each state is assumed to be offset in some degree by the flat differential, but this is only an assumption, while the principle of the graduated expense

loading is an easily demonstrable truth and the preparation of a formula for its application not a difficult task.

The argument advanced in favor of the experience rating loading of one per cent., while probably not intended seriously by its author, is symptomatic of a tendency induced by the necessity of "explaining" rates. The experience rating plan was itself based on assumptions and the contention that its results show experience rated risks to be of a higher grade than risks not so rated involves a further assumption that the earlier assumptions were correct. It would be productive of great good if the mental energy expended in "justifying" rates could be turned toward improving them on the basis of a frank recognition of defects, often warranted by lack of information and the exigencies of a practical situation. Certain of the factors now used which rest largely on assumptions are not for that reason invalidated. But every effort should be made to replace the assumptions with facts.

Probably the 1917 Conference did its best work in accomplishing a careful readjustment of basic pure premiums in the light of greatly increased and more accurate statistical information. The new pure premiums, especially those for classifications with a wide exposure, represent less of judgment and more of experience than ever before.

The recognition of new factors and of new principles, embodying a tendency to consider detailed, as well as broad means and results, points the way for future development. The greatest possible aid to such development should be found in the application of statistical tests and in the comparison of statistical results under various methods. Such studies, yielding more and more accurate information, should gradually furnish sound bases for the elimination, adoption and readjustment of methods. Perfect justice may be unattainable, but it can be much more closely approached.

MR. JOHN L. TRAIN:

Mr. Ryan in his paper recites in a clear and concise manner the action taken by the augmented Standing Committee on Workmen's Compensation Rates in revising workmen's compensation rates. As the manufacturers are more and more, especially as compensation rates are being increased, taking an interest in the methods used in making such rates, I hope that this paper can be sent generally to manufacturers' associations throughout the United States.

The work of this rating conference was a great improvement over that of the conference held in the winter of 1915. Results of that conference were not acceptable to many of the states and were not adopted, fortunately, by New York State. The objections made to the rates of the conference of 1915 were that no factors were included for three important elements, namely underestimates of outstanding losses, increasing cost, and effect of schedule rating.

At that time, it seemed to be clearly realized that some factor should be included in the multiplier for each of these items, but these factors were seemingly excluded because the amount to be included in the multiplier could not be definitely arrived at. Had these multipliers been included as they should have been, the insurance companies would not have experienced the losses sustained in writing this class of business during 1916. In this revision of rates, therefore, a long step forward has been taken by the committee.

As Mr. Ryan points out in his paper, additional problems will have to be considered when workmen's compensation rates are again revised; two in particular; the question of graduated law differentials and expense loading. The various tests made by the Rating Conference clearly indicated that there should be a graduated law differential, but I am satisfied that such graduated law differential should not be made on the basis of the premium rate alone. The manual shows many classifications wherein premium rates are the same, where in one case the premium is based almost entirely upon death losses and in another case upon other classes of injuries. Any defect in the plan adopted by the last conference in not adopting any system of graduated law differentials is, of course, offset to a very considerable extent by the fact that there should also be considered the question of a graduated expense loading.

The basic pure premiums established for the various classifications this year were, of course, much more accurate than those previously established on account of the increased experience available to the Committee. However, in 1915 there was for a number of classifications, a large volume of experience and the additional experience on those classifications did not materially change the pure premium. In fact, the Committee this year in a great number of such classifications re-established the pure premium arrived at in 1915. Year by year, with additional experience, the number of classifications which have been rated on the basis of classifications with analogous hazards, will be reduced and the problem of establishing basic pure premiums will, to a great extent, solve itself. The great problems in the field of establishing proper workmen's compensation rates for the future seem to rest more upon what factors of loading should be included in the rates, and the weight of each factor.

MR. EDMUND S. COGSWELL:

Mr. Ryan has furnished us with a valuable description of the work of the Augmented Standing Committee on Workmen's Compensation Insurance Rates, which met in New York City for several weeks during the first three months of 1917 for the purpose of making a general rate revision. He commences his paper by

calling attention to the necessity of increased rates as shown by the returns to the New York Insurance Department for the policies issued in New York during the years 1914 and 1915. As of September 30, 1916, the indicated loss ratio for 1914 issues was only 51.29 per cent., but for 1915 issues the loss ratio had increased to 68.16 per cent. It is interesting to compare these loss ratios with the combined results of Massachusetts Schedules W. Schedule W, 1915, showed for the stock companies a loss ratio of 84.12 per cent., and Schedule W, 1916, showed a loss ratio of 81.57 per cent. in spite of the fact that on May 1, 1916, increased rates went into effect. The mutual companies, some of which charged higher rates than those in effect for the stock companies, showed a loss ratio of 63.37 per cent. according to the 1915 Schedule W, and 68.77 per cent. according to the 1916 Schedule W.

The benefits under the Massachusetts Workmen's Compensation Act were considerably increased on October 1, 1914, but no increase in rates took effect until May 1, 1916. Schedule Z, 1915, showed for the stock companies a loss ratio of 73.65 per cent., and for the mutuals 58.17 per cent. for the period from October 1, 1914 to expiration, for policies outstanding on October 1, 1914. Schedule Z, 1916, which was filed in April, 1917, a few weeks after the adjournment of the Rate Conference, showed a loss ratio for the stock companies of 78.77 per cent., and for the mutuals 60.72 per cent. for the period from October 1, 1914 to expiration. One cause of the lower loss ratio of the mutual companies is that some of them charge premiums higher than those of the stock companies. Schedule Z, 1916, included the experience from October 1, 1914 to expiration on policies outstanding on October 1, 1914, and the full experience of the issues of 1915. The increased rates of May 1, 1916 applied to policies outstanding on that date which were written on and after July 1, 1915, otherwise the loss ratios would have been even higher. As the expense ratio of the average stock company according to Schedule W was 40.13 per cent. for 1915 and 38.83 per cent. for 1916, it will be seen that the companies were losing money in Massachusetts as well as in New York.

After mentioning the reasons for the calling of the 1917 Rate Conference, Mr. Ryan explains in his paper the work performed by the various committees. The principal committee made a careful revision of the pure premiums of the classifications in the Manual. While numerous changes were made, the pure premium level was increased only one-half of 1 per cent. Before the Conference had finally completed its work, tests made by Mr. G. F. Michelbacher showed that the new pure premiums reproduced the Massachusetts losses with remarkable fidelity, the excess of the actual losses over the projected losses being only $\frac{8}{10}$ of 1 per cent. After all the pure premiums had been determined and the Conference had adjourned, the Workmen's Compensation Bureau of the Massachusetts Insurance Department made a final test and found that the projected

losses almost equalled the actual losses, the difference being only $\frac{6}{10}$ of 1 per cent.

The marked difference for Group 1 of the table below is due to the large payroll for the classification "Clerical Office Employees," and the marked difference for Group 5 is due to the classification "Drivers." For this latter classification the Conference adopted a pure premium of 61 cents, but as the Massachusetts experience showed a much higher pure premium, the Massachusetts Bureau adopted an exception and made the pure premium for this state 74 cents.

MASSACHUSETTS—PART I—SCHEDULE Z, 1915.

Group No.	Basic Pure Prem.	Payroll.	Ratio of Actual to Projected Losses.
1	.03 to .10	$211,562,654	.725
2	.11 to .20	256,725,059	.985
3	.21 to .34	281,665,591	.990
4	.35 to .47	162,065,147	.993
5	.49 to .67	89,993,060	1.066
6	.71 to 1.23	88,389,907	1.034
7	1.29 to 1.78	23,399,561	1.035
8	1.86 to 7.09	35,834,832	.998
Total.....		$1,149,635,811	1.006

The Massachusetts Insurance Department also made a test of the Part II experience as shown by Schedule Z, 1915, and the ratio of actual to adjusted losses was 1.391, or about the same as appeared at the Conference.

MASSACHUSETTS—PART II—SCHEDULE Z, 1915.

Gsoup No.	Basic Pure Prem.	Payroll.	Ratio of Actual to Projected Losses.
1	.03 to .10	$72,827,888	.928
2	.11 to .20	72,965,640	1.523
3	.21 to .34	69,556,026	1.405
4	.35 to .47	55,949,719	1.297
5	.49 to .67	30,150,860	1.584
6	.71 to 1.23	28,732,091	1.405
7	1.29 to 1.78	8,261,509	1.108
8	1.86 to 7.09	9,177,498	1.477
Total.....		$347,621,231	1.391

The large difference in Group 5 is due to the classification "Drivers." The Massachusetts Bureau has adopted a higher pure premium than that adopted by the Conference. The results of the tests made before the Conference adjourned are shown in Mr. Ryan's paper (see *Proceedings,* Volume III, page 186).

The Manual Committee of the Massachusetts Rating and Inspection Bureau made a study of the Massachusetts experience shown in Schedule Z, 1916, which was filed in April, 1917, and as a result made about 140 exceptions to the pure premiums as shown in the Basic Manual. At least one-fourth of these exceptions are of minor importance so far as Massachusetts is concerned, and were made merely for the sake of consistency, for when the committee changed the pure premium for an important classification it also changed the pure premiums for classifications in the group which were of similar hazard even though some of these classifications showed little or no payroll in Massachusetts. Exceptions were made mainly for classifications where the Massachusetts Schedule Z showed a payroll of over $500,000 for either Part I or Part II. Tests have been made by the Insurance Department for the classifications where a payroll exposure of over $500,000 on either part of Schedule Z, 1916, has been reported: first, to see how closely the basic pure premiums multiplied by the payrolls would reproduce the losses, and secondly to see how nearly the pure premiums adopted by the Massachusetts Bureau would accomplish the same result. It will be noted that the basic pure premiums failed to reproduce the losses as shown on Schedule Z, 1916, by 1.4 per cent., whereas the Massachusetts pure premiums almost exactly reproduce the losses. As the statement has sometimes been made that exceptions are almost invariably downward, it is interesting to note that in Massachusetts the opposite occurred, and the result of the exceptions made for the important classifications is to increase slightly the premium income.

There happen to be a number of important classifications for which the Massachusetts Bureau adopted pure premiums ranging from .49 to .67, where the Part II experience showed much higher pure premiums than did Part I, the ratio exceeding 2.00 for some of the classifications. Combining the experience for both parts on

COMPARISON OF PROJECTED AND ACTUAL LOSSES USING BASIC PURE PREMIUMS.

Part I—Massachusetts Schedule Z—1916.

Group No.	Pure Prem.	Payroll.	Proj. Losses.	Actual Losses.	Ratio of Actual to Proj. Losses.
1	.03 to .10	$ 191,748,117	$ 82,957	$ 55,102	.664
2	.11 to .20	244,019,800	355,440	348,955	.982
3	.21 to .34	263,485,939	704,356	702,216	.997
4	.35 to .47	143,608,489	607,911	602,210	.991
5	.49 to .67	86,153,203	500,303	504,012	1.007
6	.71 to 1.23	70,077,399	605,013	623,050	1.030
7	1.29 to 1.78	19,316,692	304,416	348,021	1.143
8	1.86 to 7.42	23,238,502	477,603	504,317	1.056
		$1,041,648,141	$3,637,999	$3,687,883	1.014

Part II—Massachusetts Schedule Z—1916.

Group No.	Pure Prem.	Payroll.	Proj. Losses.	Actual Losses.	Ratio of Actual to Proj. Losses.
1	.03 to .10	$ 174,724,670	$ 75,801	$ 93,109	1.228
2	.11 to .20	177,351,708	260,629	378,995	1.454
3	.21 to .34	214,595,444	574,721	818,975	1.425
4	.35 to .47	134,045,053	559,428	828,201	1.481
5	.49 to .67	75,202,756	433,070	720,347	1.663
6	.71 to 1.23	55,556,390	478,275	670,625	1.402
7	1.29 to 1.78	15,901,983	248,018	325,226	1.311
8	1.86 to 7.42	15,622,906	324,019	552,195	1.704
		$ 863,000,910	$2,953,961	$4,387,673	1.485

COMPARISON OF PROJECTED AND ACTUAL LOSSES USING PURE PREMIUMS ADOPTED BY MASSACHUSETTS RATING AND INSPECTION BUREAU.

Part I—Massachusetts Schedule Z—1916.

Group No.	Pure Prem.	Payroll.	Proj. Losses.	Actual Losses.	Ratio of Actual to Proj. Losses.
1	.03 to .10	$ 188,706,975	$ 79,916	$ 50,553	.633
2	.11 to .20	251,608,012	359,873	361,435	1.004
3	.21 to .34	276,562,675	742,138	755,115	1.017
4	.35 to .47	106,412,303	451,602	459,274	1.017
5	.49 to .67	83,273,228	468,649	426,205	.909
6	.71 to 1.23	89,151,665	735,711	737,652	1.003
7	1.29 to 1.78	20,217,364	300,572	336,668	1.120
8	1.86 to 7.42	25,715,919	549,262	560,981	1.021
		$1,041,648,141	$3,687,723	$3,687,883	1.000

Part II—Massachusetts Schedule Z—1916.

Group No.	Pure Prem.	Payroll.	Proj. Losses.	Actual Losses.	Ratio of Actual to Proj. Losses
1	.03 to .10	$ 171,781,211	$ 72,858	$ 77,215	1.060
2	.11 to .20	184,016,012	265,799	404,731	1.523
3	.21 to .34	222,384,566	595,133	857,328	1.441
4	.35 to .47	102,796,519	435,553	582,752	1.338
5	.49 to .67	77,119,114	428,666	681,132	1.589
6	.71 to 1.23	71,196,953	584,199	852,711	1.460
7	1.29 to 1.78	16,307,222	241,167	340,252	1.411
8	1.86 to 7.42	17,399,313	373,588	591,552	1.583
		$ 863,000,910	$2,996,963	$4,387,673	1.464

The Total Payroll of Schedule Z, 1916, Part I, is less than shown in Schedule Z, 1915, because one company, which went into the hands of a receiver, did not file its Schedule Z at the time the schedules of the other companies were filed.

In some tables the payrolls of certain classifications have been omitted, either because the classifications have been eliminated, or special rates

adopted for individual risks, as for example under the classification "Chemical Mfg. N.O.C." For these reasons the payroll for Part I is $57,159,813 less than appears in Table T of the latest report of the Massachusetts Insurance Department. The amount of payroll not included in the tests involving Part II experience is $35,213,965.

such a classification on the 1.45 differential basis which was the basis used by the Massachusetts Manual Committee in its work, produced a pure premium lying between that shown for Part I and that shown for Part II.

This in large measure accounts for the Group 5 experience on the basis of the Massachusetts pure premiums being out of line for both Parts I and II as shown by the tables.

The tables prove that the law differential factor (which includes some increasing cost) of 1.45 which was inserted in the present Massachusetts multiplier is not too high.

A test has also been made by the Massachusetts Department of the experience of the classifications for Part II of the Massachusetts Schedule Z, 1916, on which less than $500,000 payroll was reported. These tests based upon a payroll exposure of $68,752,266 show ratio of Actual to Projected Losses of 1.513 if the basic pure premiums are used, and 1.458 if the Massachusetts pure premiums are used.

The work of the Actuarial Subcommittee of the Standing Committee in determining the various factors for the state multipliers, which Mr. Ryan describes in some detail in his paper, was accepted in most of the states. California, Pennsylvania, Wisconsin and Massachusetts however adopted multipliers somewhat less than would have been worked out if all the Committee's factors had been used without modification. The factor of 1½ per cent. loading for profit was not approved in Massachusetts, and in some other states, because the Insurance Commissioners believed that the interest on the invested assets was a sufficient source of profit for the companies.

As Massachusetts had adopted a modified form of the Industrial Compensation Rating Schedule which it was believed would produce a balanced rating schedule the factor for the effect of schedule rating was not adopted by the Massachusetts Rating and Inspection Bureau, and as Pennsylvania was not using this schedule, this factor was not applicable there. The pure premiums of classifications in the basic manual subject to schedule rating were loaded 9 per cent. for the effect of schedule rating, and the symbols printed were those after the loading had been applied. Thus Classification No. 3632, "Machine Shops—no foundry," for which the Committee had selected a pure premium of 47 cents and which appeared in the former manual with a rate symbol "CB," now carries the symbol "CD," the symbol of a 51 cent pure premium. This made it difficult to use the new basic manual in Massachusetts. An at-

tempt was made to use the basic manual by printing a list of classifications subject to schedule rating and which pure premiums contained the 9 per cent. loading, but the resulting manual was cumbersome and with the several exception sheets required by the action of the Massachusetts Bureau in adopting so many changes, it was necessary to look at seven or eight pages in some instances to determine correctly the rate for a classification. The Massachusetts Bureau decided to print a separate manual and Pennsylvania has done the same. If the Basic Manual is to be used in the future everywhere throughout the country, if the factor for the effect of schedule rating is continued, steps should be taken by the next conference to avoid this difficulty.

In his paper Mr. Ryan mentions the discussion which took place concerning the adoption of a graded expense ratio and states that this is one of the two questions where a thorough and early investigation is exceedingly desired. In making the Pennsylvania rates the Pennsylvania Rating and Inspection Bureau gave much consideration to this subject, and a graded expense loading was adopted.

Mr. Ryan calls attention to the various problems of compensation rate making which are not yet solved—among them the questions of a variable law differential and a graded expense ratio, and recommends the establishment of a permanent organization as was suggested at the Conference. Recently the Standing Committee on Workmen's Compensation Rates has been reorganized under the name of the National Reference Committee, the present membership of which comprises the following:

Maryland Casualty Company,
Royal Indemnity Company,
The Travelers Insurance Company,
New York State Insurance Fund,
Liberty Mutual Insurance Company,
Utica Mutual Compensation Insurance Corp.,
Massachusetts Insurance Department—*Chairman.*

This Committee has recently created an Actuarial Subcommittee, the members of which are Messrs. Greene, Chairman, Flynn, Moore, Mowbray, and Woodward. This Subcommittee is to take up the questions which were not settled at the last Conference, and before another Conference is called, attempt to lay out a method of procedure along scientific lines. The first work of this Committee is to recommend a suitable and justifiable basis for the determination of minimum premiums, as the action of the Augmented Standing Committee in increasing the minimums for many classifications has caused protests in New Jersey, New York, Massachusetts, and other states.

A history of the 1917 Conference is being prepared by the National Workmen's Compensation Service Bureau as Secretary of the Augmented Standing Committee, and those who are interested in the history of compensation rates will await the publication of

this document with interest. Meanwhile Mr. Ryan has performed a real service by giving us a full outline of what transpired.

MR. HARWOOD E. RYAN:

(AUTHOR'S REVIEW OF DISCUSSIONS.)

In closing the discussion it may be well to supplement that portion of the paper which has to do with the expense loading. I have had several inquiries with reference to the nature of the specific items which go to make up the expense loading for New York, which is 36 per cent. of the gross rate. As such items have a general application, it seems proper to set forth the provision which has been made for them in the rates. In making reference to the several percentages it should be borne in mind that they relate to the highest level of rates in the United States at the present time, hence those items of expense which are not incurred in direct ratio to the gross premium must, for any lower rate level, be more liberally provided against.

NEW YORK EXPENSE LOADING.

Item.	Per Cent. of Gross Rate.
(*a*) Acquisition cost	17.5
(*b*) Administration or home-office expense	5.5
(*c*) Investigation and settlement of claims	5.5
(*d*) Inspections and accident prevention	3.5
(*e*) Taxes, licenses and fees	2.5
(*f*) Payroll audits	1.5
	36.0

An expression of opinion on the subject of this paper which possibly may be of interest appears in a letter received by the author from a gentleman in Switzerland who is intimately associated with the underwriting of workmen's compensation insurance. The letter is of peculiar interest because it expresses a somewhat different viewpoint from that which has been heard from underwriters in this country. Unfortunately it was received so recently that it has been impossible to obtain permission to publish the name of its author. With this exception the letter is reproduced in full:

"ZURICH, November 26, 1917.

"*My dear Mr. Ryan:* You have been kind enough to send me a copy of the very interesting paper read by you at a meeting of the Casualty Actuarial Society on the subject of Revision of Workmen's Compensation Rates. This has had my best attention and I wish to thank you for your kindness in sending same to me.

"With reference to your remarks concerning the law differentials

—page 179—permit me to mention that it seems highly desirable and of greatest importance that the subject of determination of the proper divisors and multipliers be reconsidered at the earliest possible time. Comparing the rates in force in the various states for risks of the so-called non-hazardous classes it is quite apparent that the very wide discrepancy between the New York rates and those of certain other states is not justified. On risks of these classes accidents of a light nature are in great majority and, the period of disability being usually short, it is evident that the duration of the waiting period prescribed by the different laws is of greatest influence on the total loss cost. In fact, a practical test will show that under certain circumstances the pure premium for risks of this kind may be even higher in Illinois, Massachusetts, Wisconsin, Pennsylvania, etc., than in New York while, on the other hand, the application of the uniform differential produces rates or premiums which are in striking contrast to the actual needs.

"The volume of experience accumulated at this time should be sufficiently broad to serve at least as a guide for the fixation of rates which are better suited to the individual hazard of a given classification or group."

There is undoubtedly a sincere desire on the part of actuaries and statisticians to reach a more satisfactory set of principles to be followed in combining the experience of several states and in projecting rates from the amalgamated data. It is necessary, however, in order to obtain for such principles a fair trial in the process of rate-making, that they be enunciated sufficiently in advance of a general rate revision so as to lend themselves to practical tests. The outstanding need of casualty insurance as at present conducted is a standardized procedure in the treatment of statistical information which will command the respect of the underwriters who, like ourselves, have been groping toward proper solutions to our rating difficulties and who, noting division of opinion on the part of the actuaries and statisticians, can scarcely be criticized for caution when innovations are proposed.

The members of this Society can do no greater service to workmen's compensation in particular and to casualty insurance in general than by the enunciation of and adherence to correct principles. One of the most encouraging things about the recent conference on rates was a greater tolerance by the underwriter of the statistician and the actuary and of their skilled methods. Indeed, one ventures to hope that the scientific viewpoint with respect to rating questions will, in the end, receive proper recognition.

RATE REGULATION—ALBERT W. WHITNEY.

VOL. III, PAGE 191.

ORAL DISCUSSION.

MR. I. M. RUBINOW: I want to just question possibly the entire accuracy of one statement on page 191 made by Prof. Whitney; perhaps I had better read it: "Where competition is restrained there is in theory the possibility of rates being too high. In practice this is a remote contingency." I don't think that the entire problem of rate regulation is solved when the adequacy of the rates has been protected. I think that on the whole it is true that, taking the business world at large, it shows a great deal more interest in protecting itself against rates that are too high than rates that are too low.

Of course, the argument can be made that competition as such tending toward low rates will prevent the necessity of any regulation of rates, so as to protect the insured against rates that are too high. But I beg to submit that in the present stage of compensation insurance, that competition isn't always effective. Of course, we all know that the whole problem of rate-making has been absorbed by organizations of insurance carriers. There always remains, of course, theoretically what has been called about fifteen years ago by Prof. Clark, "potential competition," the possibility of the organization of new carriers, which may act as a threat and keep the rate down, as it is supposed to act as a threat and keep prices of the manufactured products down. But potential competition takes a long time in working itself out and isn't always effective. Of course, in industry potential competition is limited in time because of the necessity of building plants. It is true that that difficulty doesn't exist in the insurance business—it doesn't take very long to build a casualty insurance company plant. But nevertheless, with modern methods of supervision of stock-floating, necessity of raising money may at various times, when financial conditions are not favorable, find sufficient opposition so that potential competition doesn't realize itself, and meanwhile the rates may remain too high. Moreover, rates may not be too high in general and yet may be too high inindividual classifications. And, of course, the opposition of the employer is always against a specific rate being to high, and he doesn't give a continental as to whether the rates of his friends are too high or not: but what he is interested in is specific rates and not the general level of rates.

I don't think that there is as yet, although there may be in the

future, a complete parallel between life insurance rate-making and compensation insurance rate-making; the difference largely being, of course, due to the fact that our science isn't as highly developed, because it is more complex than life insurance is. And for that reason, it may be true that the danger of rates that are too high has been eliminated in life insurance and has not yet been eliminated in compensation insurance.

I want to close with the statement—and to make it absolutely safe, I shall make it foreign—that if you remember, the rates in England for several years were too low; that is, considering the methods of the business, the total rate was too low to meet the total expense, although, of course, it was adequate to meet the net cost and provide for a reasonable expense loading, but after struggling along for several years without having the scientific methods that we have developed in a much shorter time, in this country, they have "jacked up" the rates, as the saying goes; and the first year after the rates were "jacked up," the insurance companies which, on the whole, previously showed a loss of three to four per cent.—at least an underwriting loss—without taking into consideration the investment profits, have showed the first year after the rates were "jacked up" a profit of twenty per cent. Now, it is possible that after that, competition which is very much more active in the English compensation business than it is in America may have reduced the rates again, but for that year, the rates were undoubtedly excessive, which is an illustration that compensation rates may very readily become too high; and no rate regulation will be complete unless it takes both limits into consideration.

MR. ALBERT H. MOWBRAY: There are one or two other points that I would like to refer to in this paper. The paper is, of course, very short, and it seems to me that Prof. Whitney may have been very discreet in confining his discussion to the question of approval of rates and leaving entirely out of consideration the question of the machinery in use for handling the general problem of making the approved rates effective and the necessity for such machinery.

Beyond merely referring to that, I don't think I will discuss that point further. But on page 192, he refers to the question of control of rates through reserves. He says: "Theoretically there might be a control of compensation rates through reserves and as a matter of history, it is interesting to know that in the first year of compensation in California a bill providing for this kind of control passed the legislature but failed of signature by the governor. In practice, however, a control of the rates themselves is doubtless to be preferred." I am not familiar with that first California measure. My impression was that that was a percentage of premium reserve basis, which after all, as far as I can see, would not get at any control of the gross rates. But there is another matter which, if it goes on, will, in my judgment, replace, to a large degree, the whole matter of rate regulation, or perhaps I

should not say replace the whole matter of rate regulation but rather create such effective rate regulation through reserves that direct rate regulation may become absolute.

I think it was two years ago Commissioner Hardison recommended to the legislature, after one of the foreign companies had withdrawn from the state, that the companies foreign to Massachusetts be required to deposit in the joint custody of the Insurance Commissioner and the Industrial Accident Board, I believe, funds to secure the payment of deferred compensation. That recommendation was enacted into law.

During the year just past a local company has failed and in the Commissioner's current report he recommends that that regulation be extended to domestic companies. As long as that requirement —of course, that may not become law—but as long as that requirement exists in the state of Massachusetts only, there will probably not be any real rate regulation in it. But it seems inconceivable to me that such a regulation can become thoroughly effective in Massachusetts without being gradually extended to the other states of the United States. When we do have—if we ever do—general legislation throughout the United States requiring the deposit of funds to secure deferred liabilities, we are going to have pretty effective rate regulation, provided there is some reasonable, proper and adequate method of determining what those deferred liabilities are, other than somebody's personal judgment. And it would not be any surprise to me at all to see ultimately through that process the casualty people placed somewhat on the same plane as life insurance.

MR. ALBERT W. WHITNEY:

(AUTHOR'S REVIEW OF DISCUSSIONS.)

Replying to Dr. Rubinow, I do not mean to say that theoretically competition in insurance will always produce reasonable rates; I mean that practically and in general I believe it does. However radical we may be in our theories of social reconstruction, competition must always be largely relied upon for the regulation of business. It appears to me that competition, when restrained, works well enough in insurance, so as not to need to be entirely displaced, at least at this stage of our development, by other machinery which would be bound, under existing conditions, to be very difficult to operate successfully.

Replying to Mr. Mowbray, I must admit that I drew that California bill myself and, if my memory serves me right, the plan was this: A state bureau in which companies were to participate was to make the workmen's compensation rates for the state. The rates, however, were to be mandatory upon the companies only for purposes of calculating reserves. Realizing that this would produce

a very inadequate control both of solvency and rate discrimination, unless the reserves were made expressly applicable to the state, we provided for a deposit of securities in the state to cover the reserves.

We tried to follow as closely as possible the procedure in life insurance. There the problem is particularly simple, for the rates are implicitly defined as soon as the mortality rate and the rate of interest are specified. In the case of compensation, the rates would have to be explicitly given.

It is very likely that the control would not have worked out so satisfactorily as in life insurance. I am sorry, however, that the plan was never given a trial.

In closing I should like to emphasize one point at least that we can apparently all agree upon—that the problem of rate determination is so serious and difficult that all interests ought to unite in its solution, and in that effort this Society should exert an important influence.

THE THEORY OF LAW DIFFERENTIALS—G. F. MICHELBACHER.

VOL. III, PAGE 195.

ORAL DISCUSSION.

MR. I. M. RUBINOW: Mr. Chairman, I have no written discussion for the reason that my paper on "The Theory and Practice of Law Differentials," which I presented yesterday, can be taken in the nature of a discussion of the same problem, which I thought was more important than a discussion of an individual paper on the same subject.

There is an advantage in not having a written discussion in that one may refer not only to the original paper, but also to the written discussions that have preceded.

I think that perhaps the essential problem has been stated, in questioning the proof of the assumption that there is a permanent and universal relationship of hazard. That would be true, all other things being equal. If all other things in two states are equal except the law, then that assumption might hold. We are, after all, measuring not the amount of human suffering, but the cost of that human suffering to an insurance carrier.

The second point is that no two things are equal, or need be equal, in two states. If you remember Mr. Scattergood's paper (Synthesis of Rates for Workmen's Compensation, 1916) perhaps one of the classic presentations of the whole subject of compensation rate-making, you remember the very lengthy formula which was caused by the number of different factors that have to be taken into consideration, even in the present stage of rate-making, and yet, all the possible factors, all the various quantities, have not been taken into consideration, even in that formula.

Let's illustrate my thought. The number of accidents in the same industry in two different states will depend upon the age of the industry. Modern plants are presumably safer than older plants. They are different in many ways: the motor power may be different, the location may be different, in two different states; the labor conditions in two cotton mills, one situated in the South and the other in Massachusetts, may be vastly different, with the exclusion of child labor in the North. For in the South, notwithstanding the modern laws, child labor does exist. Then there is the difference in the relation of woman labor, which is a factor of great variability just at present; the difference in racial competition, in educational standards (to mention only a few variants). So that in actual practice, we ought to expect to find what we really do

find—that the physical hazards in the same industry of different states don't need to be always in the same proportion that we would expect. And, of course, there also comes in the question of the difference between an actual differential in certain classifications and the general flat level differential.

Now, if that assumption of correspondence of hazard relations, while theoretically sound, other things being equal, in practice isn't sound and it falls down, then I may be permitted, as one of the original men who have worked out the theory and the practice of law differentials, to say that we have got to reverse the entire process and admit, instead of claiming, as we do, that a law differential is the type, the normal and that exceptions may be provided for—instead of that, admit that the local rates should be based upon local experience and that the law differential methods must also remain a catch-all for such classifications, which evidently cannot be based upon local experience.

Now that, of course, would mean that the very theory underlying your basic manual breaks down. I say it with a good real of regret, because I had a good deal of faith in the sentiment attached to it; but instead of hoping that we may get nearer to it, we might as well frankly admit that we will get farther and farther away from it.

I should think that perhaps I may make a few remarks in regard to the general discussion of rate-making, because, after all, many of those papers fall in the line and treat of the same subjects. The whole difficulty is that the employer is bound to expect a good deal more light on the rate-making in the future than he has in the past. I think the attitude a few years ago was that rate-making is so mysterious in compensation, that it would be hopeless to expect the individual employers to understand it. And I think the argument frequently was made that the complications of certain methods are more desirable because of their complications.

That thing wouldn't hold with a large and important employer, and our industry, of course, is constantly coming into the hands of large employers. Assuming proper cost accounting in any plant, which means inquiry into every element of cost, whether it be taking place in the plant itself or by payment to an outside agent, you have got to recognize that there is bound to come an inquiry from the employer of every risk. And the local experience very frequently is going to govern over and above a formula that has been sent in from outside the state; unless the employer can be convinced that rate-making has come to such a high state of perfection and is done by people who have absolutely no interest in the matter, he is unwilling to waive his own responsibility.

Now, when I say that, I do not mean to throw any reflections upon the motives of the men who are making the rates at present. It isn't intended as a reflection upon the casualty men, because that

same unconscious influence might, and is being, felt by the actuaries of the mutuals and by the actuaries of the state funds. It doesn't make any difference what the particular business connections are. But evidently rate-making must be done by people who have no business connections, whose business it is to make rates for everybody, and who are not at the same time connected with one particular institution or branch of the insurance business.

Then possibly you might influence the employer to admit that somewhere a body, an absolutely impartial body, exists whose judgment in those matters must be better. I want to bring out the point that I haven't brought out in my paper yet—not only is the continuation of the use of the Massachusetts basic law, the old law as a basis, undesirable and open to criticism from many employers —and to illustrate, one very large employer in the copper industry in the West asked me: "Will you tell me any reason why the copper-mining rates in this state should be based upon the cost in Massachusetts? I know that there are no copper mines in Massachusetts," and I couldn't meet his argument. Of course, you might talk to him about Massachusetts as an abstract, a standard law, but you could never convince any practical employer to see the wisdom of it.

Now, if that was the inevitable method, if we had to have some abstract law upon which to base all our rates, no matter what the particular industry we are dealing with, of course then we could meet the criticism. But, as a matter of fact, I do not personally see any necessity for having one basic law, and I don't think that a system of law differentials requires it, though it has in the past.

With a proper institution for making a very much more profound study of differentials than has been made in the past, with a much more complicated system of law differentials, my idea is that the basic state and basic act for each group of classifications should be the particular state or group of states where that particular classification has the greatest experience.

So if you are dealing—to come back to the copper industry—if you are dealing with copper-mining rates, you have got to take for your basis—Utah or Arizona, and not Massachusetts; and, of course, if you are dealing with cotton goods, you may take Massachusetts as a basis.

All this gets back to the idea that I tried to convey yesterday, that there is an imperative need for the public, an efficient institution, where the entire time of its officers is devoted to the making of rates and law differentials. And the cost of it doesn't need to scare the business, with a hundred million dollars' premium income a year. I could quote individual risks whose insurable interests, you might say, in this particular problem—whose difference between a proper and improper rate for one year, would be able to support the entire rate-making institution for several years. I am thinking of one risk whose premium on a basis prepared by a

formula—Massachusetts basis, with the ordinary loading for expenses—would have amounted to $250,000, the loading on that particular hazard being over a hundred thousand dollars. They refused to pay it, and they didn't insure and they are running their own insurance department that costs about $25,000—a difference there of $75,000, which would more than pay for all the actuarial work that is called for in the law differentials.

AGE, OCCUPATION AND RESIDENCE AS VARIANTS OF THE RATE OF SICKNESS—ALBERT H. MOWBRAY.

VOL. III, PAGE 213.

WRITTEN DISCUSSION.

MR. WALTER I. KING:

If it were not for the war we would, without doubt, find ourselves much further advanced in the throes of socialistic propaganda and thus be dealing more intimately with the question of state insurance, especially compulsory health insurance. It remains to be seen whether the war will increase or decrease the socialistic tendencies. Yet the country in general was so nearly pledged to compulsory health insurance before the war absorbed the most of our attention, it behooves its actuaries and statisticians to inform themselves thoroughly on the subject that as far as they can they may direct the steps of this country in the right direction.

Almost every country, which has had extensive workmen's compensation experience, has found that compulsory health insurance is a logical adjunct of such insurance. The experience of Austria, indicated in the following quotation, has been the general experience:

"While sickness or other temporary disability may be due to causes other than industrial, the policy of making compulsory insurance against sickness a feature of the industrial organization of a country is now regarded in Austria as the only practicable solution of the problem. Although the causes of sickness arise in part from the physical and mental constitution of the individual workman and in part from general living conditions, both causes are strongly influenced by occupation, by influences connected with occupation and in particular by the general standard of life of the individual as fixed by his occupation and the income derived therefrom."* 24th Annual Report of the U. S. Dept. of Commerce and Labor, page 226.

It is not surprising then that we find compulsory health insurance agitated in the United States and the thanks of the Society are due to Mr. Mowbray, who, with his characteristic insight and aggressiveness, has called our attention to this subject and in so doing indicated for consideration some of the points which must

* This is given as a fact of conditions in other countries without any intimation that these same conditions exist in the United States.

necessarily be dealt with in coming to any conclusion relative to the proper rate of morbidity under compulsory health insurance.

Our real knowledge in regard to the incidence of morbidity has advanced very little during the last one hundred and twenty-five years, although we have learned considerable about the rate of morbidity in various orders and organizations. This is without doubt due to the intricate nature of the problem at hand and the many and various influences affecting the rate of sickness. In mortality statistics we deal with the contingency of death—the happening of one event about which there can be no rules and regulations and concerning the happening of which there can be no doubt, while in morbidity statistics we not only have to deal with the happening of an event and its duration, but with many and various rules relative to what constitutes the event itself as well as the time of commencement, the duration and recovery. Furthermore, we are dealing with a contingency, the actual existence of which can be easily faked and, therefore, much fraud perpetrated through malingering and camouflage. It can be seen, therefore, that we are dealing with a very complicated and complex problem, about which we cannot be too careful in drawing conclusions, especially conclusions of comparison.

For these reasons there has been no one, as far as I am aware, who has attempted in any published table to give anything more than the rate of morbidity in the particular organization under study. The incidence of morbidity of any general group of people has not been published. It is, then, of the utmost importance that the various characteristics of the various published tables be thoroughly understood in order that proper conclusions may be drawn from these tables with respect to new problems, as they arise.

The function of morbidity depends upon the occurrence of disability and the period of disability. It follows, therefore, that our term "rate of sickness," as Mr. Mowbray says, "is generally taken to mean the average number of days . . . of sickness per persons under observation for one year." There is, however, a point here which is worthy of notice. In America where health insurance has been taken voluntarily by the insured and the contracts reserve the right of cancellation by the companies, there is no particular inducement for an insured to pay a premium during disability in the event such premium falls due during said period of disability. Statistics for such contracts should be based upon the total number of days of disability following the occurrence of a disease, provided only the disability commenced during the year under observation. Where the insurance is compulsory, however, the premiums are payable annually whether the life is active or disabled and in such an event there will be considered in any one year only such numbers of days of disability as fall within the year under observation and following the occurrence of disability within that

year, together with any continued days of disability from the previous year observed.

Such a distinction makes considerable difference in the rates obtained and should be borne carefully in mind in comparing rates. This goes to show how important it is with health insurance to see that the facts of each group compared contain no fundamental differences that would vitiate any such comparisons.

Mr. Mowbray escapes any such comparisons by drawing conclusions from each individual experience. We must not think, therefore, that the rates are comparable. There is one impression which one might get from the wording of the paragraph at the top of page 215 and that is, we can by using the statistics of the insurance institutions of those countries where such insurance is compulsory obtain the index of morbidity for compulsory insurance in the United States. I do not believe Mr. Mowbray meant to give this impression and I only call attention to it so that it might not be taken as an authoritative statement some time in the future for using these rates as representative rates of morbidity in the United States under compulsory insurance.

Even in those organizations where insurance is compulsory, the rules and regulations of the body and the manner in which they are carried out is a great, if not the greatest, single influence on the rate of morbidity. Take, for instance, the experience of the Leipzig Local Sick Fund with respect to its compulsory and voluntary membership as published in Table 1 of Mr. Mowbray's paper. The rates for ages 15 to 19 under voluntary membership are greater than the rates for ages 65 to 69 under compulsory membership and practically this whole distinction is caused by the rules governing membership and the consequent selection in the one group and not in the other. This variance is much greater even than that indicated by age, occupation or residence and while it is an extreme case, it is indicative of the care which must be exercised in handling such figures.

We have another good illustration of the influence of rules and regulations on morbidity statistics in the increase in the rate shown by the successive published experiences of the Manchester Unity and I can probably do no better than to quote Mr. Watson's paper referred to by Mr. Mowbray: "In drawing attention to such experience I would remind the reader that permanent incapacity is very much a matter of supervision, both medical and administrative, and the self-interest which theoretically might be presumed to dominate the management of such purely mutual institutions as the English Friendly Societies is frequently subordinated, especially in the wealthier of these bodies, to the promoting of sympathy and kindred tolerance with the result that the moral qualities of the individual frequently exercise too large a part in the measurement of the disabled risk." (4th International Congress of Actuaries, Vol. I, page 481.) In explaining this increase in

rates Mr. Watson says such explanation is probably found in a great measure in the growth of the funds of the friendly societies, leading on the one hand to an increase in the habit of leaning on the societies and on the other to an imprudent relaxation of restrictions formerly considered necessary for common protection.

There is no doubt, I think, in the minds of those who have studied the subject that age, occupation and residence all act as variants with respect to the rate of morbidity. Such facts have been brought out by most every experience published, with the possible exception of the experience on commercial health insurance as written in the United States. The first table about which anything is known was one published by Dr. Price in 1789, to be used in connection with the poor laws in England. This was based upon the theory that under age 32, $\frac{1}{48}$ of the Society would be incapacitated through sickness. From age 32 to 42, $\frac{1}{4}$ more than $\frac{1}{48}$ would be so incapacitated. From age 43 to 51, $\frac{1}{2}$ more than $\frac{1}{48}$; from age 52 to 58, $\frac{3}{4}$ more than $\frac{1}{48}$ and from age 58 to 64, $\frac{1}{24}$. It was first believed that the figures for ages under 32 were based on actual experience but this has not been proven and it is quite probable that the whole table was based on the general assumption that as life approaches its close, sickness becomes more frequent in the ratio as life becomes less valuable.

This table was followed in 1823 by tables prepared by Mr. W. Morgan and Mr. Frend on the following assumption:

Ages.	Number Incapacitated.
10 to 25	1 in 46.222
25 to 30	1 in 37.828
30 to 40	1 in 32.00
40 to 50 to 65	1 in 27.66

This table was known as the Northampton Sickness Table. In 1824 the first table drawn from actual experience was published by the Highlands Society in Scotland, which showed that sickness increased gradually with advancing age, the rate of disability being increased nearly $\frac{1}{10}$ part of a week for every five years up to age 40; between ages 40 and 50 more than a week; between ages 50 and 60 nearly two weeks and between 60 and 70 nearly six weeks. Thus it will be seen that what first in England was assumed to be a matter of common sense has proved in subsequent experience to be correct, namely, that with advancing age there occurred a decreasing resistance to withstand disease and a decreased recuperative power to recover from disease.

In Germany the cost of insurance has been figured as a percentage of the workingman's wage and hence the function of age did not enter into their statistics. This, however, was found to be

a mistake and in later years their experiences have been based upon age groups. With this in view the following quotation is of interest: "Throughout the special study of the statistics of sickness based on the experience of the Leipzig Fund special emphasis is placed upon the importance of age grouping. It is pointed out that unless information concerning the age grouping of the total number of persons forming the basis of the statistics is known, serious errors are likely to occur in computing sickness and other rates." And again, "the writers of the report on the Leipzig Fund have, therefore, applied the rule that to obtain trustworthy rates of sickness *not only the age grouping of the persons included in the cases* of sickness, or days of sickness, must be known, but also the age grouping of the total number included in the occupation or industry."

In using Chart 1, page 218, I think it would be well to point out the fact that it is useful only as showing the increased rate of morbidity with advancing age for each individual class here studied. The actual rate for each society and the steepness of the curve of morbidity are both affected by various causes in each individual society and they, therefore, should not be used as a comparison of the rate of morbidity between the societies.

I do not think Mr. Mowbray would have gone too far had he been more emphatic in regard to the almost uselessness of the figures of the companies writing commercial health insurance in the United States to give any true index of the incidence of morbidity among any class of people in this country. As is pointed out in my paper read before this Society in October, 1915, entitled "Accident and Health Insurance from an Actuarial Viewpoint" (*Proceedings,* Vol. II, p. 49), this experience can represent little more than a rate of sickness among a class of lives which are constantly kept superstandard by the weeding out of the weak lives and those who through impaired vitality would be less able to withstand disease. In other words, these statistics are little more than a measure of what might be called the accidental diseases of life and as such it is a small wonder that they present almost a constant rate for all ages under 50. We have sufficient evidence, however, in the tables used by Mr. Mowbray and other experiences to clearly demonstrate that it is most important to take account of age distribution in considering morbidity statistics.

Occupation and residence are also important factors, but whether they are as important as age is a question. We are all familiar with the fact that certain occupations, if followed for any length of time, will produce definite diseases. We are also familiar with the fact that the rate of sickness in certain territories has been greatly decreased through improved sanitation, but just what influence this would have upon figures that would be applicable to compulsory health insurance in the United States is a question. It is clearly evident that in considering experiences already published, it is of

utmost importance to ascertain if there was anything about occupations of the groups insured that would materially affect morbidity. On the other hand, under a general compulsory health law, where all occupations would be grouped together, the feature of occupation and residence would bear about the same relationship toward general morbidity as it does in life insurance toward general mortality. That is to say, there are some occupations and some localities where the hazard would be so much greater than the average hazard as to make risks in such occupations or territories substandard when compared with the general morbidity of a heterogeneous group.

This is partly shown in Mr. Mowbray's first conclusion under Sickness Rates by Occupation; i. e., "the extent of variation in sickness rates with occupation is much greater when individual occupations are used as a basis of distinction than when the industry in which the worker is employed is the basis." This simply means that there is less variation in morbidity in any occupation from the general average of all occupations, than between the more and less favorable occupations, and except in the few cases of extreme extra hazard, for practical insurance purposes most occupations can be grouped together, thus giving us what Mr. Walter S. Nichols would call "true insurance."

In closing these few remarks, I wish to reiterate Mr. Mowbray's remark that the subject is worthy of study, and express my regret that these strenuous times have kept him from going further. There is a good opportunity, however, for some one who has time to study into the published tables with a view to adjusting them for their various differences as to rules, etc., so they can be compared.

ORAL DISCUSSION.

MR. I. M. RUBINOW: I am almost ashamed of myself, Mr. Chairman, for getting up so often, but I don't think it would be quite fair to myself not to say something when the question of health insurance is being discussed.

I think Mr. Mowbray has done a good service in pointing out the essential variants of age and occupation and locality (rather than residence, although, of course, residence itself might have an effect —plumbing conditions of the residence—but from a broad insurance point of view, it is the locality problem that is of rate-making importance). There is no doubt, even from the amount of limited experience that has already been accumulated, that occupational differences and the industrial differences are very much more important than the age difference, notwithstanding Mr. King's statement. I don't see how any one could read the figures that are available and make the statement that Mr. King has made, that the age differences are of greater importance. I don't think it is quite correct to say—I am afraid that I will have to direct myself

more against what Mr. King has said than against what Mr. Mowbray has said, because on the whole I agree with Mr. Mowbray's presentation of certain data—I don't think that there is any basis for the statement that European experiences are unavailable, because already sufficient experience is accumulated in this country to indicate that our own sick rate will fall somewhere between the sick rates of various European countries.

I don't want to make a guess whether it is going to be nine days or six days or four, because some European countries indicate four days' sickness and others go up as high as nine and ten, but the essential, the important thing in constructing plans for health insurance is to know that it is sufficiently important to be a subject for legislation, and also that it isn't going to be so high that it would make an insurance system impossible. I am making this very trite observation because of the statement that our own sick rate is going to be so very much higher than European experiences have shown. And that for that reason alone, we must discard European experience. It is one of those contradictions that has developed in the discussion of health insurance. In one breath we are ready to say that we are such a healthy race that we don't need it, and in the other that we are such a sick race that we can't run an insurance plan. I might mention a few others; and I am not making any argument for health insurance, because this isn't the subject for discussion, but there must be some logical consistency in statements. For instance, we say on one hand that we are too rich to need health insurance and on the other hand that we are too poor to afford it, and we say that voluntary insurance is just as good; can accomplish everything that compulsory insurance can; and we also say that compulsory insurance has accomplished nothing that is good and everything that is bad.

There is a substantial volume of experience in America. Mr. Mowbray has quoted a good deal of that. I think you will find a good deal of it gathered together from printed sources, and also a good deal of additional first-hand information, in the California Social Insurance Commission's report. My own estimate for California was six days. Dr. Warren's estimate for the country at large was nine: possibly this more correct for the country at large. I was dealing with sunny California—don't forget that. Mr. Mowbray will agree with me that there is no other place as healthy as California. The investigations of the Metropolitan Life Insurance Company seem to approach nearer to Dr. Warren's estimate of nine days, which is, on the whole, in correspondence with the German experience.

There is one point that I think Mr. Mowbray has not emphasized —if he has referred to it, I am not sure—and that's an important actuarial point for all of us, who undoubtedly in a few years will be investigating the subject (I may say parenthetically that there are at present about eight or nine states investigating the subject,

so there is an opportunity for at least eight actuaries to do some work) that no published statistics, with possibly very few exceptions, can undertake to give the actual sick rate. What they do give, when gathered under health insurance laws, is the average number of days compensated for, and you can readily see that that is an entirely different statistical category. Sickness is a very elusive sort of phenomenon. I don't think it is all camouflage, because if it were, our health insurance companies wouldn't be writing any business, because surely they are not insuring against camouflage, but it is a psychological condition.

Very often I get up in the morning and I feel very sick—not too sick to go to the office, but I do not feel well. That sort of thing isn't being compensated for. It is very largely an opinion, a feeling. The essential difference between the general sick rate and the compensated sick rate is that in the latter case it must be an opinion of two people. It is like a note that carries two signatures is always better than a note that has only one signature. A man isn't compensated because he feels that he is too sick to go to work, he is compensated if somebody else agrees with that opinion.

Then another thing. He may not be too sick to go to work, but so sick that he shouldn't go to work; and that is a very important consideration. Very often the man in his anxiety to be a faithful worker may insist that he is not sick enough to stay away, but his physician may insist that he should, and that is the main reason why in the European sickness experience the number of sick cases has been constantly rising, which was in some people's opinion an indication of camouflage. It isn't: it is because the physicians' opinions are becoming more liberal; and a man is compensated not only when he wants to stay at home, but when he should stay at home.

There is another factor, a statistical factor that disturbs the series. Various provisions of the insurance system may limit compensation, either in the beginning or in the end of sickness. We are all, of course, familiar with this phenomenon under compensation, except that in health insurance those limits, in the beginning, are less stringent than our compensation limits are—very seldom over three days, and at the end of the sickness very much stricter than compensation limits are, varying from thirteen to fifty-two weeks. Twenty-six is the standard average.

Now, no figures published in Europe attempt to give the true sick rate; they only give the compensated sick rates within the limits, and that is another factor that must be taken into consideration. I assume from reading Mr. Mowbray's paper that it was not to give the actual statistical data. I believe that his purpose was to give you some illustrations of a problem, and from that point of view the paper must be discussed and the importance of those variants in constructing sick rates and planning for an administrative system of health insurance must be given consideration.

Those two problems are not necessarily tied up. It is assumed that because there are variants that therefore the organization of health insurance must adjust itself to those variants.

Now, a life insurance company insures people of various ages and a health insurance company insures people at various sick rates and charges them various rates if it wants to. The great difficulty, as Mr. Mowbray has pointed out, is not with the variants. It isn't even the fact that the famous actuaries of England have made the same mistake that was made by Mr. George King of the Institute of Actuaries of Great Britain, and assumed that the age variant is more important than the age limit, and then made all kinds of complicated provisions for the age variants and haven't made any provision for the occupational variant, that they nearly ruined a good many of the funds. The greatest difficulty with the British system—a difficulty which doesen't exist in any other system in the world, and we hope will not exist in this country—is that they have written into the law the rate of insurance, uniform for everybody, with the only adjustments to age variants on a basis not of the rates, etc., but of a sliding scale of benefits; which is, I think, the most illogical form of insurance that could be provided.

There is another very important consideration I want to bring up. All those variants refer to the worker. The plans in this country, as far as they have been developed, include the medical aid to the family and medical aid is a very substantial part of the whole cost of health insurance—a very much larger part than is true of compensation. You can readily see what a great statistical difficulty that introduces. The combined amount of sickness due to the family and the cost of its medical care would be varying, according to entirely different principles, between a single man and a married man, and according also to the size of the family; and you would have to combine all those things, or variants, with the variants referring to the worker himself, which Mr. Mowbray analyzed that you had. If it were really true that you had to either legally or morally adjust your rate to the particular hazard of the person, the problem of rate-making would be extremely difficult indeed, and especially difficult because the plans as they stand at present are contemplating the distribution of the cost between employer and the employee and the state. For instance, a tremendous pressure would be created against the married man, the man with a large family.

As a general problem in the philosophy of insurance is it imperative that we do take care of all those variants? It may be imperative that we permit the insurance carrier to take those variants into consideration; and that was done in the American drafts; that is, the American drafts of the bill specifically state that the carriers may, if they wish, adjust their premiums, not to the age, but to the occupational hazards. But is it necessary from an insurance point of view that it should be done? Now, that

might appear to some of you a very heretical question, whether it is necessary to adjust the premium rates to the hazard, but, now, really, is it socially necessary? We may want to do it, and we may not want to do it; and without arguing the comparative advantages of the two plans, I want to say that much, that the prevailing system in Europe is not to carry those fine differences into the rate. If the Leipsig Fund, for instance, with 200,000 employees, some of whom are young men, some of whom are old men, some of whom are single and some of whom have large families (the Germans have large families), if they are quite willing to charge everybody the same percentage of rates, perhaps we might want to do the same thing. We must not forget that, after all, while I am not going to try to make any form of definition of insurance for fear that Mr. Blanchard may read it at the next meeting of the Society, it is a question of mutual protection. Mutual insurance in this country may not be scientific, but it exists; and in so far as it is dangerous, it isn't that they are not making sufficient lines of distinction, it is because the reserve conditions may be unsafe. But if a body of people want to get together for mutual insurance, without calling attention to every specific factor of difference in hazards, they ought to be permitted to do so.

After all, life insurance has been very far from taking all the different variants into consideration; they are only taking one, age. It happens that in life insurance it is an important variant, but there are other important variants, and if I should become a miner tomorrow, my life insurance policy will remain in force, although my hazards of death will increase very much; and yet we are not speaking of life insurance as a most scientific business. So, while I am not going to say what is going to be the form of health insurance in this country, it is very likely to happen that those many variants, no matter how interesting they are, may not be used. There is one safeguard, however, and that is provided in European practice and also provided in American plans, and that is the development of establishment funds. They are very convenient carriers of insurance, as any manager of an establishment fund and any large establishment will tell you. They are convenient for administrative purposes and exactness of the risk. There is no difference of locality, etc., and they also have the tremendous advantage of taking in the same occupational hazards.

MR. ALBERT H. MOWBRAY:

(AUTHOR'S REVIEW OF DISCUSSIONS.)

I have very little to say in closing except that I think I have accomplished what I set out to do when I wrote the paper. Dr. Rubinow has discussed it very much from the standpoint of the bill that was drafted by the American Association of Labor Legislation.

A recess committee of the Massachusetts Legislature presented a certain report for changing workmen's compensation conditions there, and while I won't go into the influences which might have prompted a response, the response of the manufacturers there in the form of a protest was such that the plans were very much upset. The proposition of general health insurance has been broached in the United States by certain people from a particular point of view. The matter is up for public general discussion. That general discussion is bound to revamp and remodel the original proposals.

So far as I have seen, the various people discussing it have been prone to lay to one side any consideration of technical questions involved; have assumed that if it is more in accordance with the American spirit, to have a voluntary system. On broad general lines, without very much definition of how it can be carried out, it can be carried out just as well as a general compulsory system; that a system of organization along trade lines wouldn't interfere with a system of organization along community lines, and that you can organize a sickness institution and sort of throw it into the river and let it swim. The spirit behind the good old I. O. U. W. was as admirable as anything we know of, and that institution during its lifetime did a large amount of good, but it did a large amount of harm, because it didn't take proper consideration of the technical problems that were involved.

It was my hope, in presenting this paper, to draw attention to some of those technical problems; and because it would be impossible to consider all the things Mr. Kopf spoke of, I picked out certain ones which seemed to stand out prominently, in the hope of putting something in the paper which might later be referred to in the discussion of the general plan; not in the thought that the technical problems necessarily overruled considerations of public policy, but that safety required that they be not altogether overlooked in the discussions.

NOTE ON THE FREQUENCY CURVES OF BASIC PURE PREMIUMS—ARNE FISHER.

VOL. III, PAGE 241.

WRITTEN DISCUSSION.

MR. EDWIN W. KOPF:

In commenting upon Mr. Fisher's approaches to some fundamental problems of higher statistical analysis in workmen's insurance, it is perhaps relevant to suggest that even our more experienced members are not yet prepared to apply the more recently developed analytic methods and criteria in their daily statistical and actuarial work. It will be a more important service to define this broad difficulty than to discuss the details of Mr. Fisher's application of higher statistical analytics to a single rating problem. The observation of W. P. Elderton on the place of modern statistical analytics in insurance science* outlines the difficulty fairly well. He says: "It is difficult to tell how far such methods may prove useful in direct application to actuarial problems, but even if they happen to be of only slight assistance, it seems advisable for actuaries to have some knowledge of the contemporary study of a subject connected with their own work on the theoretical side." This statement was addressed to life insurance actuaries. As far as it pertains to the statistical foundations of life insurance this observation still holds to a very great extent. In its fundamentals, life insurance makes no extended demand upon applied logic and the other elements of statistical philosophy beyond the sound discussion of dichotomous classification of data and the analysis thereof.

Casualty and social insurance, however, demand manifold classification of sense data and of insurance experience. When we deal analytically with the highly complex social facts subject to manifold classification, we are required to employ methods specially suited to our data not to be found in the technical equipment of statisticians who deal only with the two facts, life and death. I believe that before proceeding with a specific rating problem in casualty insurance, Mr. Fisher should first attack the broader question of showing the nature and necessities of the analytic methods in social statistics which must be used in order to intelligently handle data requiring manifold classification. Our members must be gradually led away from the simple, comfortable statistical dis-

*"Frequency Curves and Correlation," p. 7.

cipline of life insurance science and of mortality statistics. Casualty and social insurance should rest upon the broader and more complex basis of descriptive and analytic social statistics and in this regard it must blaze a new trail in the statement of statistical difficulties and solutions. I do not believe Mr. Fisher has made it sufficiently clear to our members, that the complex social phenomena, subject to manifold classification, which are set forth in our ambitious syllabus, have inherent characteristics which demand the application of the higher tests. Data which is to be presented in manifold classification, must be tested for stability, class-homogeneity, frequency distribution, and to other preliminary analysis before we can arrive at any final and valid conclusions.

Many of our members have a false sense of security in dealing with statistical data. They have too much faith in a mystic "law of large numbers" and of statistical consistency and regularity. In the present crude state of descriptive social statistics, the one thing which confronts us is baffling irregularity. We may say with Richmond Mayo-Smith as regards our methods of social statistical analysis: "It must never be forgotten that the best work in statistics remains to be done, not so much in world-wide investigations covering millions of individuals, where all local influences are effaced, as in the more minute investigations of particular conditions, where the specific forces can be detected."

Before we apply the very useful methods of the analytic statisticians, we need a statement of the nature and deficiencies of our descriptive data and a clear outline of the reasons why higher statistical concepts and methods are necessary for drawing conclusions. Only upon the basis of such a statement can we base a number of detailed lines of related inquiry and to understand the place in our technical equipment of the valuable methods such as Mr. Fisher has given us in his articles.

Editor's Note.

Mr. G. F. Michelbacher submitted a written discussion of Mr. Fisher's paper, which has been omitted from the record because of Mr. Michelbacher's admission that he made an error in reaching the conclusions which he submitted in his written discussion.

ORAL DISCUSSION.

Mr. Albert H. Mowbray: I haven't heard the previous written discussion, and I must apologize somewhat for the remarks I am going to make, because I have promised myself and really planned to do some preliminary mathematical work in order to better understand this paper before it came up for discussion at this time. Business pressure, as it has a habit of doing, has prevented my doing so. But, if I understand the paper correctly, I am quite at

variance with what I have heard of the earlier discussion. I am very sorry a committee meeting prevented me being here earlier to listen to the entire discussion.

One of the fundamental problems which is presented to us in rate-making is this: Given a certain payroll exposure, in a particular classification (a million dollars, four million dollars, one hundred million dollars), and a given pure premium indication, upon which it is hoped we may be able to predicate a future rate, is the payroll exposure sufficient that we may properly predicate a future rate upon that exposure? I raised that question in a paper presented at the first meeting of this Society (*Proceedings*, Vol. I, p. 24), and, as I take it, Mr. Fisher's paper is intended to show us methods, improved methods over those I suggested at that time, for attacking that problem.

I don't understand that Mr. Fisher intends to suggest to us new ways of rate-making, but rather new ways of analyzing our experience from the standpoint of whether or not it is a satisfactory experience for future rate-making. In that way, Mr. Fisher would undertake, as I take it, in considering an American experience, to first test it for stability; that is to say, to determine whether the influences producing losses were steady or fluctuating in their operation during the period under observation.

I am afraid, from what I have seen of our recent American experience, that he would early come to the conclusion that there were changing influences, such as changes in compensation laws, etc., for which we would have to allow. But assuming that the experiences then have passed that test, as I interpret his paper he proposes that we take certain methods to determine whether the experience in a given classification or group of classifications is sufficiently broad to justify making a rate from it, or, assuming that we have made a rate from it, he attempts to answer the question—How far may we expect departure in our future experience from the rate basis, from the basis of our rate-making?

Now, from that point of view, without, as I say, having had the time to critically analyze Mr. Fisher's method, I think this paper is a very important paper and one to which we should all give very careful consideration, because it appears to give us a very useful tool.

MR. ARNE FISHER:

(AUTHOR'S REVIEW OF DISCUSSIONS.)

First of all I wish to mention that none of my critics present at this meeting have noticed the greatest error in my paper. It is curious that this error was found, not here in America, but in two so widely differently located places as those of China and England.

I recently had a letter from a Mr. Kai Chi Chow, in Shanghai,

wherein he states: "Your coefficient of disturbancy has interested me greatly, but also somewhat disturbed my peace of mind, because I am not able to verify your results."

Then I received another letter from Mr. W. R. Strong, of London, England, who happens to be a member of our Society. To Mr. Strong belongs the credit of calling my attention to the fact that the Bernoullian dispersion as computed on page 243 was assigned the value of 1.5601, whereas it ought to be 0.15601. In other words, the decimal point is in the wrong place. This gives the Charlier coefficient of disturbancy a value of about 7, which must be considered high. Hence my conclusions at the top of page 244 are absolutely erroneous.

This error, however, is due to careless computation and not to the method, and it is a rather significant fact that it has been completely overlooked here in America and discovered in two almost antipodal parts of the earth.

With these preliminary remarks I shall proceed to answer the various criticisms of my little note. Mr. Kopf states in his remarks that it will be of more service to define the difficulty certain members have in applying modern statistical analysis in their daily work than "to discuss the details of Mr. Fisher's applications of higher statistical analysis to a single rating problem." The very fact that Mr. Kopf does not intend to discuss the paper itself necessitates no further comment on my part. I agree, however, fully with the speaker's remarks that "many of our members have a false sense of security in dealing with statistical data," and that tests are required for stability and frequency distribution. These requirements I have always emphasized in the short papers I have submitted to the Society.

The admission by Mr. Michelbacher that he "made an error in reaching the conclusions which he submitted in his written discussion," and the subsequent withdrawal of this discussion, makes further comment superfluous on this rather unfortunate episode, which properly may be ascribed to a somewhat youthful effervescence of Mr. Michelbacher. I might therefore properly add a quotation from the English mathematician, Chrystal, "that the indiscretions of a great man should be quietly allowed to be forgotten."

Reviews of Books and Publications.

Course of Employment in New York State from 1904 to 1916. (Special Bulletin No. 85, New York Department of Labor.) New York, July, 1916. 50 pp.

One of the most interesting pamphlets that has come to hand in some time is Bulletin No. 85 of the New York Department of Labor, dealing with the extent of employment and unemployment in New York State from 1904 to 1916. This Bulletin presents in more elaborate form the material appearing in the monthly pamphlet, "The Labor Market," issued by the same department, with some supplementary material relating to the same subject, covering a more extensive period, and derived from different sources. In the appendix of the report is also a careful description of the material underlying the chart which appears in the monthly bulletin and also the method of using the material. This with supplementary charts is reproduced in this Bulletin.

In view of the extent to which the figures from this monthly pamphlet and the chart based thereon have been quoted in discussion of the problem of variation of accident frequency with industrial activity, and its relation to compensation rate making, it is perhaps well to point out one thing which is made clear in this appendix. The figures relating to number of employees and wages of employees are derived from returns of a representative list of firms showing the actual number of employees and the actual wages paid for the payroll period which included the fifteenth of the month, the period usually being one week. Thus, the figures and the chart present the total number of employees regardless of whether they are working part time, full time or over time, and the total wages paid them. When business is slack and the employees are working part time the line of number of employees tends downward, but because industrial establishments resort to reduced hours and short time rather than to wholesale dismissals, under such conditions the wages line tends downward more rapidly. Likewise in very active times it is customary to work over time as well as take on more employees. Under such conditions the wages

line, independent of any increase in the basic wage of the individual employee, tends to rise more rapidly than the line for number of employees. If we do not bear this in mind we are apt to assume from a study of these charts that wage scales are and have been increasing even more rapidly than they have.

The only way to present this same material without leaving open the possibility of such erroneous conclusions is to present the data with respect to number of employees upon the basis of "full time workers" in the same manner as that in which some of the German statistics have been presented. Of course, it is impossible to present material such as that collected by the New York Department of Labor in this way, and these remarks are not intended as a criticism of what has been done by that Department, but rather as a possible help to correctly understand what has been presented.

This practical impossibility of getting suitable returns for comparison with those shown undoubtedly prevented the New York Department of Labor from presenting concurrently with these tables some data which would indicate what proportion of the excess in the rapidity of increase in wages over number of employees is due to over time work and what part of it is due to actual increase in the wage level. Each student must, therefore, make his own investigations to determine the extent of the allowance which he feels should be made for this factor.

ALBERT H. MOWBRAY.

Labor Law Administration in New York. American Association for Labor Legislation, June, 1917. 285 pp.

The above quarterly publication of the American Association for Labor Legislation is a critical review of the New York State Industrial Commission's progress during the period June 1, 1915, when it was organized, to June 30, 1916. The New York Bureau of Municipal Research worked in conjunction with the above Association in compiling the report. The following is quoted from the introductory note of the report. "The survey here recorded has taken longer and proven a more formidable undertaking than was anticipated. During its course more than thirty joint conferences have been held at the headquarters of the Association for Labor Legislation. Those who have directed it are fully aware of its incompleteness and imperfections, but believe that it contains so much

of value for other states that are planning to organize industrial commissions to administer their labor laws, and for the people of New York state in order that they may have an intelligent and vigorous appreciation of the enormous tasks that have been imposed upon their industrial commission and may support and develop it accordingly, as to justify the immediate publication of these findings."

The first part of the report contains a short historical review of the "Development of Agencies for Administering Labor Legislation in New York State" and a brief summary of the "Problems Confronting the Commission." The first labor bureau established in New York State was the Bureau of Labor Statistics which was organized in 1883. In 1915 the various bureaus were consolidated under the Industrial Commission. "Upon assuming office the members of the industrial commission naturally encountered many difficulties, not only in bringing about expected economies of administration and perfecting the administrative machinery of these various bureaus and their subdivisions, but in acquiring an understanding of the problem in its entirety and of the social and economic possibilities of good labor legislation ably administered." One chapter of the report is devoted to a description of the organization of the Commission and the manner in which the time of the various commissioners is divided. A large part of the commissioners' time is devoted to administering the workmen's compensation insurance act. There are five commissioners and each commissioner has one or more bureaus over which he has supervision. The remainder of the review is devoted to a description of the organization and work of the various bureaus. These bureaus are as follows:

Bureau of Industrial Code,
Bureau of Inspection,
Bureau of Fire Hazards, Boilers and Explosives,
Bureau of Workmen's Compensation,
Bureau of Employment,
Bureau of Industries and Immigration,
Bureau of Mediation and Arbitration,
Bureau of Statistics and Information.

The industrial council is a body of ten members representing in equal numbers employers and employees created to advise and co-

operate with the Commission. The legal division gives legal advice to the commissioners and to the heads of the various bureaus. The civil service supplies employees for the various bureaus.

The report contains definite recommendations for the future organization and work of the Industrial Commission and the various bureaus coming under the Commission.

EVERETT S. FALLOW.

CURRENT NOTES.

Health Insurance.

Two recent publications give a convenient summary of contemporary opinion on health insurance plans and prospects in America. In Proceedings of the Conference on Social Insurance, Washington, D. C., Dec. 5 to 9, 1916 (*Bulletin of the United States Bureau of Labor Statistics, Whole Number 212*), there is an extensive symposium. The discussion was arranged under the following topics:

I. Existing agencies.
II. Proposed legislation for health insurance.
III. Some problems of sickness insurance for women.
IV. Fundamental considerations in health insurance.
V. Medical benefits and services.

The American Labor Legislation Review for March, 1917, gives the papers on health insurance which were read before the meetings of the American Association for Labor Legislation at Columbus and Cincinnati, Ohio, in December, 1916. The various papers were arranged under the several topics of: (*a*) need for health insurance, (*b*) medical organization, (*c*) organization of funds, (*d*) principles of health insurance.

Swiss View of the Effect of the War upon Private Insurance.

Dr. Hermann Renfer, vice-director of the Swiss Insurance Office at Bern, discusses the effect of the war upon private insurance at considerable length in an article published in the *Journal of the Swiss Statistical Society*, 1917, Part 1. The financial and administrative problems in life and miscellaneous lines of insurance created by war conditions are very thoroughly analyzed.

History and Theory of Compensation Rates.

The National Workmen's Compensation Service Bureau announces the publication of the following pamphlet:

Report of the Work of the Augmented Standing Committee on Workmen's Compensation Insurance Rates-1917, Together With a

Brief Account of the History and Theory of the Making of Workmen's Compensation Insurance Rates.

The title is self-explanatory as to the scope of this report. Copies may be secured from the Bureau (13 Park Row, New York) at the rate of 50 cents per copy.

Medical Benefits under Workmen's Compensation.

In a detailed study of provisions for medical benefits under American compensation acts, Dr. I. M. Rubinow (*Journal of Political Economy,* June and July, 1917) points out, in summary, that "the entire problem of medical aid to victims of industrial accidents is still awaiting solution in this country, and this one problem emphasizes how much remains to be done, undone and done over in our compensation legislation. Sufficient attention and thought has not been given to this matter. A very erroneous sense of economy has placed limitations upon the extent of medical aid which is producing injustice to the injured and harm to society without really saving anything to the employer. Evidence is not lacking of a gradual realization of these facts in the minds of those concerned with the practice of compensation. . . . It must be followed by careful study, . . . and above all by an organized social effort to improve and at the same time to cheapen the administration of medical service, and only then will the appalling waste of human energy and well-being through accidental injuries be brought down to the irreducible minimum."

Serious Sickness among Wage Earners in Pennsylvania and West Virginia.

The Metropolitan Life Insurance Company has issued a report on its investigation into serious sickness among wage earners in Pennsylvania and West Virginia during March, 1917. In these states the inquiry into sickness covered 374,001 persons among whom were found 7,333 cases of sickness involving disability for work, or at a rate of 19.6 per 1,000 exposed. The data were very thoroughly studied and the several characteristics of the sickness disability rate according to sex, age, principal occupation and area classes were pointed out. In addition, certain questions in medical economics such as the percentages of cases with physician in attendance, the character of medical service available to wage earners

in the particular areas and occupation groups and the durations of sickness were also discussed in some detail. The report concludes with a composite table covering all the company's sickness surveys over the period 1915–1917. A graphic chart brings out the characteristics of the rate for serious sickness at the several age periods. Copies of the reprint may be had upon application to the company, 1 Madison Avenue, New York City.

General Liability Statistical Plan.

The General Liability Statistical Plan given below has been approved by the Central Statistical Committee in co-operation with the Actuarial Department of the National Workmen's Compensation Service Bureau. It will become effective on January 1, 1918, for all general liability business written on and after that date.

General Liability Statistical Plan.

I. *Effective Date of Plan.*

General Liability Statistics shall be kept according to this plan beginning January 1, 1918, for all policies issued on and after that date. At this time it is contemplated to issue the first call for experience under this plan on or about June, 1920. The call will be for experience for policy year 1918 with losses paid and outstanding brought down to December 31, 1919.

II. *Punched Card System.*

The plan has been constructed so that either mechanical sorting and tabulating or the ordinary long-hand method may be used.

III. *Uniform Method of Reporting.*

The following points with regard to uniform method of compiling general liability statistics are to be emphasized:

(*a*) The companies may keep the statistics in any manner convenient to their statistical procedure and use any codes they may individually devise.

(*b*) In reporting to the Bureau, however, the experience must be compiled in a uniform manner according to the method outlined in the plan and the reports must be made on blanks which will be furnished by the Bureau.

(*c*) The adoption of the procedure outlined in the plan will promote uniformity and save labor in the preparation of statistical data for the Bureau.

IV. *General Liability Statistics to be Compiled by Years of Issue.*

The statistical data must be kept and tabulated by year of issue. This method requires:

(*a*) The allocation of exposure and premiums for a given policy to the year in which the policy was issued. For examples, the area, frontage, or elevators, and the premiums under a policy issued during the calendar year 1918, including all developments such as additions to or decreases in exposure or premiums, must be charged to the year 1918 irrespective of the year in which the items are actually entered on the company's books.

(*b*) The allocation of each loss (both the paid portion and the amount estimated to be outstanding) to the year of issue of the policy under which the loss was incurred, regardless of the date of the actual payment.

V. *Forms of Coverage.*

This plan provides for the compilation of statistics on the following forms of coverage:

1. (*a*) Owners', Landlords' and Tenants' Public Liability. (For purposes of this plan O. L. & T. Public Liability shall include only area and frontage; the elevator or any other portion of the policy to be put under the proper form.)
   (*b*) Theater Public Liability.
   (*c*) Miscellaneous General Liability (such as signs, vending machines, dance halls, etc.).
   (*d*) Residences and Farms.
2. (*a*) Policies written on a flat charge (providing such coverage as temporary reviewing stands, etc.).
3. (*a*) Elevator Public Liability (shall include elevator experience under O. L. & T. Public Liability policies).
4. (*a*) Landlords' Protective Liability (written at 50 per cent. of Manual rates for any or all of the above forms of coverage. See note).
5. (*a*) Employers' Liability (to be reported under Employers' Liability experience).

VI. *Compilation of Experience.*

(*a*) Experience shall be compiled separately for each form of coverage.

(*b*) Experience for each form of coverage shall be subdivided according to premium basis, i. e., according to nature of the exposure. For example, O. L. & T. Public Liability policies are written to cover both area and frontage. In the case of area the premium is calculated on the basis of a given rate per 100 square feet of floor space; with respect to frontage the premium is determined on the basis of a given rate per lineal foot of frontage. Consequently, the experience for O. L. & T. Public Liability policies will be compiled and reported in two main divisions, viz.:

(1) O. L. & T.—area.
(2) O. L. & T.—frontage.

(*c*) Each main subdivision for each form of coverage shall be further subdivided by classifications.

(*d*) The experience for Landlords' Protective Liability shall be reported separately and subdivided in the manner described in items (*a*) and (*b*) of this paragraph.

Note: Landlords' Protective Liability.—O. L. & T. Public Liability and Elevator Public Liability policies (and we are given to understand also Theater Public Liability and Miscellaneous General Liability) are written at 50 per cent. of manual rates to cover an owner or general lessee of a building who has leased the building, with entire control of the premises, to another, generally called the tenant. The endorsement which is required to be attached to such policies stipulates certain conditions, two of which are mentioned above. Manifestly Landlords' Protective Liability coverage does not present the same degree of public liability hazard as the straight O. L. & T. Public Liability or Elevator Liability. Hence the necessity for reporting Landlords' Protective Liability as such separately, subdivided as follows:

(1) Area.
(2) Frontage.
(3) Miscellaneous General Liability.
(4) Theater Public Liability.
(5) Elevators.

VII. *Premium Basis.*

The premium bases in General Liability Insurance vary considerably. Some of the more prominent bases are indicated below:

(1) O. L. & T. Public Liability:
   (*a*) Area Premium is based upon total floor area of a building, expressed in square feet, and classification of the building.
   (*b*) Frontage Premium is based upon the length of the street frontage, expressed in lineal feet, and the classification of the building.
(2) Elevator Public Liability. Premium based on one elevator according to classification of the elevator.
(3) Theater Public Liability. Premium based on the number of seats and the classification of the theater.
(4) Miscellaneous General Liability. Premium bases are as follows:
   (*a*) Advertising Signs. The size of sign, expressed in square feet, and the kind of sign.
   (*b*) Vending Machines. The number of machines.
   (*c*) Baseball Clubs or Parks. Bath Houses—Beach. Exhibitions—Agricultural, etc. Horse Shows. Premium based on receipts, a definite percentage of receipts being charged as premium.
(5) Residences and Farms. Premium based on number of dwellings and acreage.

(6) Policies written on a flat charge basis. There is no specific basis of premium.

(7) Employers' Liability. Premium based on payroll, the same as in compensation insurance.

VIII. *Exposure.*

(1) O. L. & T. Public Liability.

(*a*) Area. The unit of exposure is 100 square feet of area insured for twelve months.

(*b*) Frontage. The unit of exposure is one lineal foot of frontage insured for twelve months.

(2) Elevator Public Liability. The unit of exposure is one elevator insured for twelve months.

(3) Theater Public Liability. The unit of exposure is one seat insured for twelve months.

(4) Miscellaneous General Liability. The unit of exposure is as follows for the various classifications:

(*a*) For classifications such as signs the premium for which is based upon area, the unit of exposure is 100 sq. ft. insured for twelve months.

(*b*) For classifications such as churches, lunch wagons, vending machines, which are written at a flat charge per unit, the unit of exposure is one church, one lunch wagon, etc., insured for twelve months.

(*c*) For classifications such as Baseball Clubs, Bathing Pavilions, etc., which are written on the basis of receipts, there is no unit of exposure, as the premium is a definite percentage of the total receipts during the policy term. In general, such exposure should be handled in the same way as payroll in compensation insurance.

(*d*) Residences and Farms. The unit of exposure for a residence together with the land upon which it is situated, but not in excess of five (5) acres, is one residence insured for 12 months.

For that portion of a risk in excess of five (5) acres, the unit of exposure is one acre insured for 12 months.

IX. *Calculation of Earned Exposure on Unexpired or Cancelled Policies.*

(*a*) Since the unit of exposure in all cases (except 4*c* under Rule VII) is a definite quantity insured for 12 months, it follows that if this quantity is insured for a period less or greater than 12 months that the earned exposure is such a proportion of the unit as the time insured is to 12 months.

For example, one elevator insured for 7 months is equal to 7/12 of unit exposure or 7/12 elevator, since the experience is always reported on the annual earned basis. Likewise, an elevator insured for 19 months equals 19/12 unit exposure or 19/12 elevator (or 1-7/12).

(*b*) Fractions of a unit of exposure should be reported in decimals as per following table:

1/12 equals .1	7/12 equals .6
2/12 equals .2	8/12 equals .7
3/12 equals .3	9/12 equals .7
4/12 equals .3	10/12 equals .8
5/12 equals .4	11/12 equals .9
6/12 equals .5	12/12 equals 1.0

Note 1.—It may appear incongruous for one church insured for 4 months to be equal to 1/3 church. This is no more so than for one church insured for 3 years to be called 3 churches, which is the present practice. It should be remembered that 1/3 church or 3 churches mean 1/3 or 3/1 units exposure, that is 1/3 or 3 church years.

Note 2.—The above method of calculating earned exposure does not apply to classifications written on the basis of receipts (see 4*c* under premium basis) as they already include the factor of time. In other words, the amount of receipts depends upon the length of time of the insurance contract in the same way as the amount of payroll in compensation insurance.

(*c*) The following is the formula to use for calculation of earned exposure in connection with policies written for a term of twelve months.

(M divided by 12) N,

where M equals the number of months the policy has been in force and N equals the number of square feet of area, or the number of feet of frontage, or the number of elevators, insured for twelve months.

(*d*) The formula to use in calculating the earned exposure in connection with three-year one-payment policies when and if the company multiplies the exposure by three and charges the increased exposure and the entire premium to the year of issue of policy is as follows:

(M divided by 36) N,

where N equals the actual annual exposure multiplied by three.

(*e*) The formula given in paragraph (*c*) should be applied by the company using for three-year one-payment policies the method recommended in Rule X.

X. *Three-Year Policies, One Payment.*

The statistical treatment of such policies varies. The present practice of most companies is to multiply the exposure by three and to charge the increased exposure, all of the premium and all losses to the year in which the policy is issued. As an example, a three-year one-payment policy covering 3 elevators, 20 feet of frontage and 10,000 sq. ft. of area, total premium $150, is issued in 1917

and is charged to policy year 1917. But since the term of the policy is three years and all the data for the policy are recorded as pertaining to one year it follows that an adjustment must be made in the exposure in accordance with rules VIII and IX. On this basis, the exposure chargeable to policy year 1917 is 9 elevators, 60 feet frontage and 30,000 sq. ft. area.

It cannot be gainsaid that such practice is the most convenient from the accounting point of view and for purposes of calculating the reserves. The drawback, and a most serious one, consists in this that it is practically impossible to determine the earned exposure at the end of a policy year, particularly by classifications, unless the calculation is made individually for each policy. For pure premium experience, which is the only basis for arriving at correct rates, it is absolutely essential to have the exposure on an earned basis. Under the above practice, in order to obtain the earned exposure for a given policy year it will either be necessary for a company to go through all the policies issued in that year and calculate the earned portion for each individual policy or for the Bureau to delay the call for experience until the fourth year subsequent to the year for which experience is desired. The first alternative means a great deal of labor, the second, experience too old to be of much value.

In lieu of this method, the following method which has been successfully applied by several companies is recommended.

Method of Allocating Exposure and Premium on Three-Year One-Payment Policies.

The premium and basis of premium (exposure) in this kind of policy is treated exactly as if there were issued three separate twelve-month policies. For example, given a three-year one-payment policy dated May 1, 1917, premium $177, the premium is divided in the manner shown below.

Policy year 1917—May 1, 1917, to May 1, 1918,	Area 12,000 sq. ft....	$12
	Frontage 120 ft.....	12
	1 passenger elev.....	35
Policy year 1918—May 1, 1918, to May 1, 1919,	Area 12,000 sq. ft....	12
	Frontage 120 ft.....	12
	1 passenger elev.....	35
Policy year 1919—May 1, 1919, to May 1, 1920,	Area 12,000 sq. ft....	12
	Frontage 120 ft.....	12
	1 passenger elev.....	35

This information for experience purposes is put on the back of the application. The companies above referred to have had proper headings and spacings prepared and they are printed on and are a part of the application.

For state analysis and reserve records the total premium is divided into three equal parts and recorded as follows on the upper margin of the application:

Policy year 1917—$59.00
Policy year 1918— 59.00
Policy year 1919— 59.00

As regards the allocation of losses, the date of accident determines the policy year to which the losses are charged. Thus losses on accidents occurring between May 1, 1917, and May 1, 1918, are allocated to policy year 1917, and losses on accidents occurring after May 1, 1919, to policy year 1919.

The amounts allocated to policy year 1918 and 1919 are treated as advance premiums and are recorded on policy year premium cards for these years. Below an illustration of the manner of recording the advance premiums is given.

ILLUSTRATION SHOWING METHOD OF CHARGING PORTIONS OF PREMIUMS ON THREE-YEAR ONE PAYMENT POLICIES TO ADVANCE YEARS.

Calendar Year.	Premiums Written in Calendar Year;	Premium Charged to				
		Policy Year 1915.	Policy Year 1916.	Policy Year 1917.	Policy Year 1918.	Policy Year 1919.
1915....	2,000,000	1,940,000	30,000	30,000		
1916....	2,500,000		2,420,000	40,000	40,000	
1917....	3,000,000			2,880,000	60,000	60,000
Total.	7,500,000	1,940,000	2,450,000	2,950,000	100,000	60,000

To take care of written business in Schedule P at December 31, 1917, for example, there should be added to policy year 1917 premiums ($2,880,000) the premiums of policy years 1918 and 1919 ($60,000 and $60,000), which are taken from the regular policy year premium cards for these years. The advance year's written figures are added to 1917 policy year figure solely to balance with income for calendar year 1917.

XI. *Three-Year Policies Payable 50–30–20.*

(*a*) The statistical treatment of such policies is uniform throughout all companies. The method is correct, being the same as that proposed for three-year one-payment policies, and is here described merely as a matter of record.

Example.—A policy dated May 1, 1917, issued for a term of three years, premium $177.00, payable as follows:

First year 50 per cent.—$88.50
Second year 30 per cent.— 53.10
Third year 20 per cent.— 35.40

The exposure and premiums are allocated as follows:

Policy year 1917—May 1, 1917, to May 1, 1918,	Area 12,000 sq. ft...	$18.00
	Frontage 120 ft...	18.00
	1 passenger elev.....	52.50
Policy year 1918—May 1, 1918, to May 1, 1919,	Area 12,000 sq. ft...	10.80
	Frontage 120 ft....	10.80
	1 passenger elev.....	31.50
Policy year 1919—May 1, 1919, to May 1, 1920,	Area 12,000 sq. ft...	7.20
	Frontage 120 ft...	7.20
	1 passenger elev.....	21.00

(*b*) The basis of premium (the exposure) is correctly allocated on an annual basis. As for premium, while it is allocated exactly as it is paid, i. e., on 50–30–20 per cent. basis, this does not affect the loss ratios materially, as the company is getting some first, second and third year payments in the same year and this in effect works out nearly the same as if the premium were apportioned on 33⅓ per cent. basis.

(*c*) Below is presented a table illustrating the fact that beginning with the third year of commencement of business and thereafter the annual premium income on three-year policies payable 50–30–20 is the same as if the premiums were paid on 33⅓ per cent. basis. This, of course, can only hold true if an equal volume of such business is written from year to year.

Year Written.	Percentages of 3-Year Premiums Paid in Years Indicated.					
	1912.	1913.	1914.	1915.	1916.	1917.
1912.....	50	30	20			
1913.....		50	30	20		
1914.....			50	30	20	
1915.....				50	30	20
1916.....					50	30
1917.....						50
Total.....	50	80	100	100	100	100

XII. *Cancellations.*

In all cases where a policy is cancelled, regardless of whether it is cancelled on a pro-rata or short-rate basis, the exposure, i. e., the basis of premium, should always be calculated on a pro-rata basis.

XIII. *Losses.*

Include under losses all allocated claim adjustment expenses, but do not include cost of inspection or unallocated expenses.

XIV. *Policy Limits.*

(*a*) In reporting to the Bureau, no subdivision shall be made by policy limits. In other words, all policies, regardless of limits, will be included in one experience.

(*b*) In lieu of subdivision by limits, the companies will be called upon for a statement of all excess losses, i. e., all losses in excess of $5,000 on any one injury, and in excess of $10,000 on any one accident involving more than one injury. This information will be given on blanks prepared by the Bureau and which will be designated "Individual Report of Excess Loss."

(*c*) Various companies are at present keeping experience according to these limits: 5,000/10,000; 10,000/20,000 and all limits over 5,000/10,000 and 10,000/20,000. The Committee recognizes that this is a proper procedure and recommends its continuance.

XV. *Deductible Average Policies.*

In the compilation of experience for any general liability line no experience on the so-called deductible average policies shall be included.

By the term "deductible average" is meant a form of policy contract under which a specific amount of each claim settlement is paid by the assured, the carrier paying the balance. If a claim is settled for an amount equal to or less than the deductible average, the assured pays the entire claim.

XVI. *Reinsurance.*

(*a*) In all cases, premiums and losses on risks which have been reinsured by the reporting company must be reported in gross. In other words, no deduction should be made for premiums paid to reinsurers and no deduction should be made for losses recovered from reinsurers.

(*b*) Reinsurance premiums received and losses paid on same must be entirely excluded from the experience.

XVII. *Coinsurance.*

In this form of insurance two or more companies jointly insure a risk on the basis of a definite apportionment of liability. For example, three companies, A, B and C, insure a risk and the following liability is assumed by each:

A takes 2/5
B takes 2/5
C takes 1/5

The premium is divided among the companies in accordance with these ratios, and any loss which may occur is likewise apportioned in the same ratios.

Supposing the total premium to be $5,000, and a total loss on the risk of $3,000, the premium and the loss are apportioned thus:

Company	Receives Premium of	Share of Loss
A	$2,000	$1,200
B	2,000	1,200
C	1,000	600
Total	$5,000	$3,000

Two methods of discharging liability obtain:

1. Each one of the participating companies pays its portion of a loss directly to the assured.

2. The initial underwriting company pays the full amount of the incurred claim and is reimbursed by the other participating companies.

Where the first method is used, each of the participating companies will have experience to report on the risk, and if some provision were not made to obviate it, the exposure when the experience is combined by the Bureau would be multiplied as many times as the number of companies participating.

Therefore, in order to avoid duplication of exposure in the case of risks involving coinsurance with the first method of loss payment, the experience on such risks should be reported separately for each risk and the name and location of the risk, also the word "Coinsurance," should be written on the report card.

Where the second method of discharging liability obtains it is evident that we have the same situation that obtains in the case of reinsurance; that is, the initial underwriting company has a record of the entire loss, whereas each of the other participating companies has only a record of its share of the loss, at least as far as it concerns accounting and statistical records.

It follows, therefore, that in the case of risks involving coinsurance together with the second method of loss payment, the experience should be reported only by the company which pays the entire loss directly to the assured and that such company should report the losses in gross.

However, to avoid the possibility of confusion, the companies will report experience on such risks in the same manner as provided for similar risks with the first method of loss payment, with the further provision that the initial underwriting company is to report the net loss and not the gross.

XVIII. *Additional Interests.*

It is considered impracticable to make a separation of experience for additional interests. However, if any company is interested in making a special study of this subject, there is nothing in the plan to prevent the tabulation of such data.

The value of experience for rate making purposes depends entirely upon the volume of the exposure which can be accumulated for each classification. A subdivision of the experience for each

classification, as would be the case if an attempt were made to secure information concerning additional interests, would spread the exposure so thinly that an adequate basis for rate determination would not be found in any classification. Furthermore, it is practically impossible to relate the losses occasioned by the "Additional Interests" coverage to the proper exposure.

XIX. *Territorial Divisions.*

(*a*) Experience for all general liability lines shall be kept by states and by cities of 200,000 population and over.

(*b*) As regards New York City, it is suggested that provision be made for keeping the experience by zones in view of the probability that it will soon be necessary to do so. A special committee of the New York Casualty Exchange, with the approval of the New York Insurance Department, is now at work on a plan to subdivide Greater New York into a number of rate zones. Though the number cannot be definitely stated at this time, it is probable that thirty and even as many as fifty zones may be established.

XX. *Minimum Premiums—Method of Pro-rating.*

In the case of a minimum premium policy it is recommended that the minimum premium be apportioned in the following manner:

(1) Compute the premium for each kind of coverage at manual rates and obtain the total premium at manual rates.

(2) Compute the ratio of premium for each kind of coverage to the total premium at manual rates and apply the ratios to the minimum premium.

Example.—O. L. & T. Public Liability policy covering 20 feet of frontage and 1,000 sq. ft. of area—minimum premium $6.00.

Premium at Manual Rates		Ratios of 1 and 2 to Total Prem.	Apportionment of Minimum Prem.
1. Area—1,000 sq. ft. at 10 cents =	$1.00	.40	$2.40
2. Frontage—20 ft. at 7½ cents =	1.50	.60	3.60
Totals	$2.50		$6.00

XXI. *Unallocated Claim Expenses.*

The amount of the unallocated claim expenses to be apportioned to the general liability business and the distribution thereof to years of issue, several kinds of business and classifications shall be determined by the Bureau in the following manner:

In order to determine the amount of unallocated claim expenses for a given year of issue brought down to a specified date the Bureau shall procure supplementary Schedule P pertaining to all lines of business combined as reported to the insurance departments on the uniform convention blank for the year of issue concerned. It shall combine from these supplementary Schedule P

the unallocated claim expenses for the specified year of issue. It shall then divide the combined unallocated claim expenses by the combined losses and allocated claim expenses, and the ratio so ascertained shall be applied as a factor against the paid and outstanding losses and allocated claim expenses of the combined general liability classification experience for the given year of issue in order to determine the amount of unallocated claim expenses for each classification.

This shall apply to Area, Frontage, Elevators, and Miscellaneous Liability, and the annual statement supplementary Schedule P used shall be for the companies reporting to the Bureau only.

Formula in connection with the above:

$$\frac{\text{Schedule P Liability Expenses (unallocated)}}{\text{Schedule P Liability Losses} + \text{Liability Expenses (allocated)}} \times$$

General Liability Paid and O/S Losses + General Liability Expenses (allocated) = General Liability Expenses (unallocated).

XXII. *Codes.*

Several codes, attached herewith,* have been constructed for use in connection with this plan. The use of these codes is optional with the companies. Should any company have more suitable codes, their existence should be made known to the Bureau in order that the best codes may come into general use.

The codes constructed for the plans are as follows:

1. State Code.
2. City Code (cities of 200,000 population and over).
3. City Code (100,000 population and over) for reference only.
4. Area and Frontage Code.
5. Miscellaneous General Liability Classifications Code.
6. Elevator Code.

XXIII. *Tabulation of Experience.*

The general liability experience shall be tabulated and reported to the Bureau in accordance with the following schedule:*

S. Bruce Black has been elected treasurer of the Liberty Mutual Insurance Co.

Arthur H. Craig is in the "Service."

James H. Flanigan is the actuary of the Bankers Life Co.

Herbert Hess is in the "Service."

Frederick L. Hoffman has been elected third vice-president and statistician of the Prudential Insurance Company.

* Not herein reproduced.

Albert H. Mowbray has been elected vice-president and actuary of the Liberty Mutual Ins. Co., heretofore known as the Massachusetts Employees Ins. Assn.

Frank R. Mullaney has been appointed actuary of the American Mutual Liability Ins. Co.

Claude E. Scattergood has been elected actuary of the Morris Plan Insurance Society.

S. Herbert Wolfe is in the "Service."

Members are requested to send to the Editor items for publication under Current Notes.

THE CASUALTY ACTUARIAL AND STATISTICAL SOCIETY OF AMERICA.

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MEMBERSHIP OF THE SOCIETY, OCTOBER 31, 1917.

FELLOWS.

Those marked (†) were Charter Members at date of organization, November 7, 1914.

Those marked (*) have been admitted as Fellows upon examination by the Society.

Date Admitted	
†	Amerine, W. M., Actuary, Georgia Casualty Co., Macon, Ga.
†	Archer, William C., Second Deputy Commissioner, State Industrial Commission, 230 Fifth Ave., New York.
†	Baldwin, F. Spencer, Manager, State Insurance Fund, 230 Fifth Ave., New York.
†	Benjamin, Roland, Comptroller, Fidelity & Deposit Co., Baltimore, Md.
†	Black, S. Bruce, Treasurer, Liberty Mutual Ins. Co., 185 Devonshire St., Boston, Mass.
Apr. 20, 1917	Blanchard, Ralph H., Instructor in Insurance, 506 Journalism, Columbia University, New York.
*Oct. 31, 1917	Brockway, U. Hayden, Travelers Ins. Co., Hartford, Conn.
May 19, 1915	Bradshaw, Thomas, Commissioner of Finance and City Treasurer, Toronto, Canada.
†	Breiby, William, Office of Fackler & Fackler, Consulting Actuaries, 35 Nassau St., New York.
†	Brodin, Richard, Actuary, United Life and Accident Ins. Co., Concord, N. H.
Oct. 22, 1915	Brown, Herbert D., Chief of U. S. Efficiency Bureau, Washington, D. C.
Oct. 22, 1915	Brown, William H., Secretary and Treasurer, Columbian National Life Ins. Co., Boston, Mass.
†	Buck, George B., Actuary, City of New York Commission on Pensions, Municipal Building, New York.
May 26, 1916	Bucklin, Walter S., President, Liberty Mutual Ins. Co., 185 Devonshire St., Boston, Mass.
†	Budlong, W. A., Superintendent of Claims, Commercial Travelers Mutual Accident Assn., Utica, N. Y.

Apr. 20, 1917	Burhop, W. H., Member, Wisconsin Compensation Insurance Board, State Capitol, Madison, Wis.
Feb. 19, 1915	Burns, F. Highlands, First Vice-President, Maryland Casualty Co., Baltimore, Md.
†	Cammack, Edmund E., Associate Actuary, Aetna Life Ins. Co., Hartford, Conn.
†	Carpenter, Raymond V., Assistant Actuary, Metropolitan Life Ins. Co., 1 Madison Ave., New York.
Feb. 19, 1915	Case, Gordon, Assistant Examiner, New York Ins. Dept., 165 Broadway, New York.
Feb. 25, 1916	Close, Charles L., Manager, Bureau of Safety, U. S. Steel Corporation, 71 Broadway, New York.
Oct. 27, 1916	Cogswell, Edmund S., Third Deputy Insurance Commissioner, State House, Boston, Mass.
†	Cole, Richard H., Secretary, Connecticut General Life Ins. Co., Hartford, Conn.
Feb. 19, 1915	Collins, Henry, Assistant Manager, Ocean Accident & Guarantee Corporation, 59 John St., New York.
†	Conway, Charles T., Vice-President, Liberty Mutual Ins. Co., 30 E. 42d St., New York.
†	Copeland, John A., Consulting Actuary, 1709 Third National Bank Building, Atlanta, Ga.
†	Cowles, W. G., Vice-President, Travelers Ins. Co., Hartford, Conn.
†	Craig, Arthur H., Lieut., Company B, 318th Regiment, Petersburg, Va.
†	Craig, James D., Assistant Actuary, Metropolitan Life Ins. Co., 1 Madison Ave., New York.
†	Craig, James M., Actuary, Metropolitan Life Ins. Co., 1 Madison Ave., New York.
May 26, 1916	Crum, Frederick S., Assistant Statistician, Prudential Ins. Co., Newark, N. J.
†	Daly, Thomas F., President, Capitol Life Ins. Co., Denver, Col.
†	Dawson, Alfred B., Miles M. Dawson & Son, 141 Broadway, New York.
†	Dawson, Miles M., Counsellor at Law and Consulting Actuary, 141 Broadway, New York.
†	De Kay, Eckford C., Recorder, New York Ins. Dept., 165 Broadway, New York.
†	Dearth, Elmer H., President, General Casualty & Surety Co., 114 Woodward Ave., Detroit, Mich.
May 19, 1915	Deutschberger, Samuel, Chief Examiner, Underwriters' Association Bureau, New York Ins. Dept., 165 Broadway, New York.
†	Downey, E. H., Special Deputy, Insurance Department, Harrisburg, Pa.
†	Dublin, Louis I., Statistician, Metropolitan Life Ins. Co., 1 Madison Ave., New York.

May 19, 1915	Dunlap, Earl O., Metropolitan Life Ins. Co., 1 Madison Ave., New York.
†	Egbert, Lester D., Office of Willcox, Peck, Brown & Crosby, Insurance Brokers, 3 S. William St., New York.
†	Epsteen, Saul, Wiggins, Col.
†	Fackler, David Parks, Consulting Actuary, 35 Nassau St., New York.
†	Fackler, Edward B., Consulting Actuary, 35 Nassau St., New York.
†	Fallow, Everett S., Assistant Actuary, Casualty Dept., Travelers Ins. Co., Hartford, Conn.
†	Farrer, Henry, Statistician, Hartford Accident & Indemnity Co., Hartford, Conn.
Feb. 25, 1916	Fay, Albert H., Statistician, U. S. Bureau of Mines, Washington, D. C.
Feb. 19, 1915	Fellows, C. W., Manager, State Compensation Ins. Fund, 525 Market St., San Francisco, Cal.
May 19, 1915	Fisher, Arne, Prudential Ins. Co. Newark, N. J.
†	Fitch, Frank M., Auditor, Hartford Steam Boiler Inspection & Ins. Co., Hartford, Conn.
Feb. 19, 1915	Flanigan, James E., Actuary, Bankers Life Co., Des Moines, Iowa.
†	Flynn, Benedict D., Assistant Secretary, Travelers Ins. Co., Hartford, Conn.
Feb. 19, 1915	Fondiller, Richard, State Industrial Commission, 230 Fifth Ave., New York.
†	Forbes, Charles S., Forbes & Co. Inc., 66 Broadway, New York.
May 26, 1916	Frankel, Lee K., Third Vice-President, Metropolitan Life Ins. Co. 1 Madison Ave., New York.
†	Franklin, C. H., U. S. Manager, Frankfort General Ins. Co., 123 William St., New York.
Feb. 25, 1916	Froggatt, Joseph, President, Joseph Froggatt & Co., Insurance Accountants, 25 Church St., New York.
†	Furze, Harry, Comptroller, Globe Indemnity Co., 45 William St., New York.
Feb. 19, 1915	Garrison, Fred S., Assistant Secretary, Travelers Indemnity Co., Hartford, Conn.
†	Gaty, Theodore E., Vice-President and Secretary, Fidelity & Casualty Co., 92 Liberty St., New York.
May 19, 1915	Glover, James W., Consulting Actuary, University of Michigan, Ann Arbor, Mich.
†	Goodwin, Edward S., Care of F. R. Cooley and Co., Bankers, 49 Pearl St., Hartford, Conn.
†	Gould, William H., Consulting Actuary, 256 Broadway, New York.

Oct. 22, 1915	Graham, George, Actuary, Missouri State Life Ins. Co., St. Louis, Mo.
Oct. 22, 1915	Graham, T. Bertrand, Metropolitan Life Ins. Co., 1 Madison Ave., New York.
†	Graham, William J., Superintendent of Group-Insurance, Equitable Life Assurance Society, 120 Broadway, New York.
†	Grandfield, Robert E., Secretary, Industrial Accident Board, State House, Boston, Mass.
†	Greene, Winfield W., Special Deputy Commissioner of Banking and Insurance, 20 Clintoni St., Newark, N. J.
†	Hamilton, R. C. L., Comptroller, Hartford Accicident & Indemnity Co., Hartford, Conn.
†	Hammond, H. Pierson, Actuary, Connecticut Ins. Dept., Hartford, Conn.
†	Hansen, Carl M., Managing Director, Pennsylvania Mutual Liability Assn., Huntingdon, Pa.
Oct. 27, 1916	Hardy, Edward R., Assistant Manager, New York Fire Ins. Exchange, 123 William St., New York.
Oct. 22, 1915	Hatch, Leonard W., Chief Statistician, State Industrial Commission, Albany, N. Y.
Oct. 22, 1915	Hess, Herbert, Sergt., Base Hospital No. 15, A. E. F. via New York.
†	Hillas, Robert J., President, Fidelity & Casualty Co., 92 Liberty St., New York.
Oct. 22, 1915	Hodgkins, L. G., Secretary and General Manager, National Automobile Underwriters Conference, 80 Maiden Lane, New York.
†	Hoffman, Frederick L., Third Vice-President and Statistician, Prudential Ins. Co., Newark, N. J.
Oct. 22, 1915	Holland, Charles H., Vice-President and General Manager, Royal Indemnity Co., 84 William St., New York.
†	Hughes, Charles, Auditor and Assistant Actuary, New York Ins. Dept., 165 Broadway, New York.
†	Hunt, Burritt A., Actuary, Liability Dept. Aetna Life Ins. Co., Hartford, Conn.
†	Hunter, Arthur, Actuary, New York Life Ins. Co., 346 Broadway, New York.
Feb. 25, 1916	Jackson, Charles W., Actuary, Postal Life Ins. Co., 511 Fifth Ave., New York.
May 19, 1915	Johnson, William C., Equitable Bldg., Equitable Life Assurance Society, Boston, Mass.
Oct. 22, 1915	Kime, Virgil M., Actuary, Casualty Dept. Travelers Ins. Co., Hartford, Conn.
†	King, Walter I., Actuary, Columbian National Life Ins. Co., Boston, Mass.

†	Kopf, Edwin W., Assistant Statistician, Metropolitan Life Ins. Co., 1 Madison Ave., New York.
Feb. 19, 1915	Laird, John M., Actuary, Connecticut General Life Ins. Co., Hartford, Conn.
Feb. 19, 1915	Landis, Abb, Consulting Actuary, 1107 Independent Life Building, Nashville, Tenn.
†	Law, Frank E., Vice-President, Fidelity & Casualty Co., 92 Liberty St., New York.
May 19, 1915	Lawson, F. W., U. S. Manager, London Guarantee & Accident Co., Ltd., 134 So. La Salle St., Chicago, Ill.
†	Leal, J. R., Actuary, Florida Ins. Dept., State Capitol, Tallahassee, Fla.
†	Leslie, William, Secretary-Actuary, State Compensation Ins. Fund, 525 Market St., San Francisco, Cal.
Feb. 19, 1915	Lubin, Harry, Public Service Commission, 120 Broadway, New York.
†	Luckett, D. G., Secretary, United States Casualty Co., 80 Maiden Lane, New York.
*Oct. 31, 1917	McManus, Robert J., Travelers Ins. Co., Hartford, Conn.
Feb. 19, 1915	Maddrill, James D., Actuary, U. S. Bureau of Efficiency, Washington, D. C.
†	Magoun, William N., General Manager, Massachusetts Rating & Inspection Bureau, 88 Broad St., Boston, Mass.
†	Marsh, W. B., Business Manager, The Economic World, 80 Wall St., New York.
May 19, 1915	Maycrink, Emma C., New York Ins. Dept., 165 Broadway, New York.
Feb. 19, 1915	Mead, Franklin B., Secretary and Actuary, Lincoln National Life Ins. Co., Fort Wayne, Ind.
Apr. 20, 1917	Meltzer, Marcus, Statistician, National Workmen's Compensation Service Bureau, 13 Park Row, New York.
†	Michelbacher, G. F., Actuary, National Workmen's Compensation Service Bureau, 13 Park Row, New York.
†	Miller, David W., 354 New York Ave., Brooklyn, N. Y.
†	Milligan, Samuel, Metropolitan Life Ins. Co., 1 Madison Ave., New York.
†	Mitchell, James F., First Asst. U. S. Manager, General Accident Fire and Life Assur. Corp., Fourth and Walnut Sts., Phila., Pa.
†	Moir, Henry, Actuary, Home Life Ins. Co., 256 Broadway, New York.

†	Moore, George D., Statistician, Royal Indemnity Co., 84 William St., New York.
†	Moore, W. S., Secretary-Treasurer, Guarantee Bonding & Ins. Co., Wichita, Kan.
May 19, 1915	Morris, Edward B., Actuary, Life Dept., Travelers Ins. Co., Hartford, Conn.
†	Morrison, James, Accountant, Royal Indemnity Co., 84 William St., New York.
†	Mowbray, Albert H., Vice-President and Actuary, Liberty Mutual Ins. Co., 185 Devonshire St., Boston, Mass.
†	Mullaney, Frank R., Actuary, American Mutual Liability Ins. Co., 245 State St., Boston, Mass.
†	Nicholas, L. A., Statistician, Accident Department, Fidelity & Casualty Co., 92 Liberty St., New York.
†	Olifiers, Edward, Actuary, A Sul America, Rio-de-Janeiro, Brazil.
†	Orr, Robert K., President, Michigan Employers Casualty Co., Lansing, Mich.
†	Otis, Stanley L., Secretary, Insurance Federation of New York State, 80 Maiden Lane, New York.
†	Pallay, Julius J., Statistician, London Guarantee & Accident Co., Ltd., 134 So. La Salle St., Chicago, Ill.
May 26, 1916	Parker, Jr., John M., Secretary, Accident and Liability Department, Aetna Life Ins. Co., Hartford, Conn.
†	Reiter, Charles G., Assistant Actuary, Metropolitan Life Ins. Co., 1 Madison Ave., New York.
†	Remington, Charles H., Assistant Treasurer, Aetna Life Ins. Co., Hartford, Conn.
Feb. 19, 1915	Rolph, Mrs. Dorothy M., Deputy Commissioner and Actuary, Insurance Dept., State Capitol, Denver, Col.
Oct. 22, 1915	Rowe, J. Scofield, Vice-President, Aetna Life Ins. Co., Hartford, Conn.
†	Rubinow, I. M., Federal Trade Commission, Washington, D. C.
†	Ryan, Harwood E., Associate Actuary, New York Ins. Dept., 165 Broadway, New York.
†	Saxton, Arthur F., Chief Examiner of Casualty Companies, New York Ins. Dept., 165 Broadway, New York.
†	Scattergood, Claude E., Actuary, Morris Plan Insurance Society, 52 William St., New York.
†	Scheitlin, E., Statistician, Globe Indemnity Co., 45 William St., New York.

†	Senior, Leon S., Manager and Secretary, Compensation Inspection Rating Board, 135 William St., New York.
†	Smiley, J. W., Actuary and Chief Accountant to the West Virginia State Compensation Commissioner, Charleston, W. Va.
Apr. 20, 1917	Smith, Charles G., Assistant Actuary, New York Ins. Dept., 165 Broadway, New York.
Feb. 19, 1915	Smith, George Lambert, Consulting Actuary, 55 John St., New York.
Feb. 19, 1915	Stone, John T., President, Maryland Casualty Co., Baltimore, Md.
Feb. 25, 1916	Strong, Wendell M., Associate Actuary, Mutual Life Ins. Co., 32 Nassau St., New York.
Oct. 22, 1915	Strong, William Richard, 39 Streatham High Road, S. W. 16, London, England.
†	Sullivan, Robert J., Secretary Liability Department, Travelers Ins. Co., Hartford, Conn.
May 19, 1915	Thiselton, Herbert C., General Manager, London Guarantee and Accident Co., Ltd., 20, 21 and 22 Lincoln's Inn Fields, London, W. C. 2, England.
†	Thompson, John S., Assistant Actuary, Mutual Life Ins. Co., 32 Nassau St., New York.
†	Train, John L., Secretary and General Manager, Utica Mutual Compensation Ins. Corp., 110 Genesee St., Utica, New York.
†	Whitney, Albert W., General Manager, National Workmen's Compensation Service Bureau, 13 Park Row, New York.
Oct. 22, 1915	Wilson, Herbert M., Director of Department of Inspection and Safety, The Associated Companies, 2407 First National Bank Building, Pittsburgh Pa.
†	Wolfe, Lee J., Consulting Actuary, 165 Broadway, New York.
†	Wolfe, S. Herbert, Consulting Actuary, 165 Broadway, New York. (Captain, United States Reserve.)
†	Woodward, Joseph H., Actuary, State Industrial Commission, 230 Fifth Ave., New York.
†	Young, William, Assistant Actuary, New York Life Ins. Co., 346 Broadway, New York.

ASSOCIATES.

The following have been enrolled as Associates upon examination by the Society.

Those marked (1) have passed Part I of the Fellowship Examination.

Date Enrolled	
(1)Oct. 27, 1916	Baridon, Felix E., Travelers Ins. Co., Hartford, Conn.
Oct. 22, 1915	Baxter, Don A., Assistant Deputy Ins. Commissioner, Michigan Ins. Dept., Lansing, Mich.
Oct. 27, 1916	Bernstein, Abraham, Accountant, State Insurance Fund, 230 Fifth Ave., New York.
Oct. 31, 1917	Bessey, John M., Actuary, Millers Mutual Casualty Co., Chicago, Ill.
Oct. 22, 1915	Brann, Ralph M., Manager, Colorado Branch, National Workmen's Compensation Service Bureau, Denver, Col.
Oct. 22, 1915	Buffler, Louis, Jr., State Ins. Fund, 230 Fifth Ave., New York.
Oct. 31, 1917	Coates, Barrett N., Berkeley, Cal.
Oct. 22, 1915	Feder, Marcy, Assistant Engineer, New York Ins. Dept., 165 Broadway, New York.
Oct. 31, 1917	Jackson, Edward T., Statistician, Maryland Casualty Co., Baltimore, Md.
Oct. 31, 1917	Kearney, T. P., Hartford Accident & Indemnity Co., Denver, Col.
Oct. 22, 1915	Levy, S. Leon, War Trade Board, 1027 Vermont Ave., Washington, D. C.
(1)Oct. 27, 1916	McClure, Laurence H., Aetna Life Ins. Co., Hartford, Conn.
Oct. 22, 1915	McGuire, Vincent G., 3056 Decatur Ave., New York.
(1)Oct. 27, 1916	Miller, Tilford W., Travelers Ins. Co., Hartford, Conn.
Oct. 31, 1917	Montgomery, Victor, California Ins. Dept., San Francisco, Cal.
Oct. 31, 1917	Mueller, Louis H., 11th Co., 166th Depot Brigade, Camp Lewis, Tacoma, Wash.
Oct. 22, 1915	Müller, Fritz, New York Life Ins. Co., 346 Broadway, New York.
(1)Oct. 27, 1916	Newell, William, Chief Safety Engineer, State Insurance Fund, 230 Fifth Ave., New York.

Oct. 22, 1915 Tilson, Howard, London Guarantee and Accident Co., 1423 Insurance Exchange, Chicago, Ill.
[1]Oct. 22, 1915 Van Tuyl, Hiram O., Assistant Examiner, New York Ins. Dept., 165 Broadway, New York.
[1]Oct. 27, 1916 Waite, A. W., Aetna Life Ins. Co., Hartford, Conn.
[1]Oct. 27, 1916 Waite, Harry V., Travelers Ins. Co., Hartford, Conn.
Oct. 22, 1915 Williamson, W. R., Assistant Actuary, Life Dept., Travelers Ins. Co., Hartford, Conn.
Oct. 22, 1915 Wood, Donald M., of Childs, Young & Wood, Insurance Exchange, Chicago, Ill.
Oct. 22, 1915 Woodman, Charles E., Examiner, New York Ins. Dept., 165 Broadway, New York.

SCHEDULE OF MEMBERSHIP, OCTOBER 31, 1917.

	Fellows.	Associates.	Total.
Membership, April 20, 1917	142	21	163
Addition:			
By Examination—Oct. 31, 1917	2	6	8
	144	27	171
Transfers from Associate to Fellow	—	2	2
Membership, October 31, 1917	144	25	169

ABSTRACT FROM THE MINUTES OF THE FOURTH ANNUAL MEETING, OCTOBER 31 AND NOVEMBER 1, 1917.

The fourth annual and ninth regular meeting of the Casualty Actuarial and Statistical Society of America was held at the Hotel Astor, New York City, on October 31 and November 1, 1917.

President Craig called the meeting to order on the first day at 10:40 A.M. The roll was called, showing the following forty-three Fellows and eight Associates present:

FELLOWS.

BLACK	FONDILLER	MOORE, G. D.
BLANCHARD	GOULD	MOWBRAY
BUDLONG	GRAHAM, T. B.	ORR
CAMMACK	GRAHAM, W. J.	PALLAY
CARPENTER	GREENE	MRS. ROLPH
COGSWELL	HAMMOND	RUBINOW
CONWAY	HUNT	RYAN
CRAIG, J. D.	JACKSON, C. W.	SCATTERGOOD
CRUM	KIME	SCHEITLIN
DEARTH	KOPF	SENIOR
DOWNEY	LAIRD	SMITH, C. G.
FALLOW	MELTZER	TRAIN
FISHER	MICHELBACHER	WHITNEY
FLYNN	MILLIGAN	WOLFE, L. J.
	MOIR	

ASSOCIATES.

JACKSON, E. T.	MÜLLER	WAITE, H. V.
MCCLURE	NEWELL	WOODMAN
MCMANUS	VANTUYL	

The President's annual address was presented.

The minutes of the meeting held April 20, 1917, were approved as printed in the *Proceedings*.

The report of the Council was read and, upon motion, adopted by the Society.

The report of the Secretary-Treasurer was read and accepted. A summary follows:

We have had a satisfactory increase in membership. Including those becoming members today, we have admitted six Fellows and six Associates, two Fellows have withdrawn and two Associates have been admitted to Fellowship, producing a net

increase of four Fellows and four Associates, a gain of eight members. The total membership is 169, as shown in the following table:

Meeting of	Fellows.	Associates.	Total.
October 27, 1916	140	21	161
April 20, 1917 (by election)	4	—	4
October 31, 1917 (by examination)	2	6	8
	146	27	173
Withdrawals	2	—	2
Transfers from Associate to Fellow	—	2	2
Membership October 31, 1917	144	25	169

In accordance with the vote of the Society at the April 20, 1917, meeting, $1,000 has been invested in Liberty Loan Bonds.

The report of the Editor was read and accepted. A summary follows:

During the fiscal year October, 1916–October, 1917, the third year of the Society's existence, Volume III of the *Proceedings* has been issued. This volume consists of Numbers 7 and 8, which are the products of the two meetings held by the Society. One thousand copies of No. 7 and twelve hundred copies of No. 8 have been printed. The growth of the *Proceedings* is shown in the following table:

	Pages.	Papers.	Discussions.	Reviews.
Volume I (Nos. 1, 2, 3)	331	16	5	6
Volume II (4, 5, 6)	521	30	7	12
Number 7	127	5	20	0
Number 8	201	9	11	6
Total, Volume III	328	14	31	6

Volumes I, II and III have been bound in buckram and supplied to members and subscribers. Volumes I and II are sold to members at $1.50 each. Volume III, however, is furnished gratis to members, in addition to Numbers 7 and 8 (constituting Volume III) which have been mailed to members promptly upon publication.

The Auditing Committee (Mr. Charles Hughes, Chairman) reported that the books of the Treasurer had been audited and his accounts verified.

The Committee on Cumulative Index (Mr. S. H. Wolfe, Chairman) reported that a large number of the papers and discussions in the early numbers of the *Proceedings* had been indexed by subtopics.

The Educational Committee (Mr. G. D. Moore, Chairman) reported that it was preparing a revision of the Society's pamphlet "Recommendations for study in Connection with the Examinations of the Casualty Actuarial and Statistical Society of America."

The Examination Committee (Mr. G. F. Michelbacher, Chairman) submitted a report, of which the following is a summary:

Examinations were held on May 2 and 3, 1917, throughout the United States. This year, Parts III and IV of the Associateship and Parts I and II of the Fellowship examinations were given.

Seven Associates registered for examination in Part I of the Fellowship examination, all presented papers and all passed, as follows:

BARIDON, FELIX E.
MCCLURE, LAURENCE H.
MCMANUS, ROBERT J.
MILLER, TILFORD W.
NEWELL, WILLIAM
WAITE, A. W.
WAITE, H. V.

Eight Associates registered for examination in Part II of the Fellowship examination, six presented papers and two passed, as follows:

BROCKWAY, U. HAYDEN
MCMANUS, ROBERT J.

These are the first men to be admitted as Fellows upon examination by the Society.

Twenty candidates registered for examination in Part III of the Associateship examination, nineteen presented papers and seven passed, as follows:

ACKER, MILTON
COATES, BARRET N.
ELSTON, JAMES S.
MARVIN, HARRY C.
MONTGOMERY, VICTOR
MUELLER, LOUIS H.
THOMPSON, ALFRED R.

Twenty-five candidates registered for examination in Part IV of the Associateship examination, ten presented papers and six passed, as follows:

BESSEY, JOHN M.
COATES, BARRETT N.
JACKSON, EDWARD T.
KEARNEY, T. P.
MONTGOMERY, VICTOR
MUELLER, LOUIS H.

They have been enrolled as Associates by direction of the Council.

The Committee on Papers (Mr. A. W. Whitney, Chairman) submitted the following recommendations as to procedure which have been approved by the Council and were duly adopted:

1. Papers are to be submitted to the Editor and not to the Secretary or any other officer of the Society.

2. Papers must be submitted at least three weeks in advance of the meeting at which they are to be presented in order to give sufficient time for all three members of the Committee on Papers to read them and arrive at an opinion with regard to the program as a whole.

3. The name of the author must not be attached to the paper. The author of the paper, however, shall disclose his identity to the Editor.

4. Three copies of each paper must be furnished in order to facilitate reading by the Committee.

Upon motion duly carried, a vote of thanks was extended by the Society to the officers and the members of the various committees for their labors of the past year and their reports were adopted.

The annual elections were then held and the officers and members of the Council, as stated below, were elected in the following order:

President ..... James D. Craig
Vice-President ..... Joseph H. Woodward
Vice-President ..... Harwood E. Ryan
Secretary-Treasurer ..... Claude E. Scattergood
Editor ..... Richard Fondiller
Librarian ..... Louis I. Dublin
Member of Council (term to expire October, 1919) ..... Virgil M. Kime
Member of Council (term to expire October, 1919) ..... Walter I. King

Upon motion, duly carried, the Council was authorized to invest, in its discretion, in any issues of United States Government War Bonds, such funds of the Society as may be available.

Recess was taken until 2:30 P.M., when Vice-President Ryan called the meeting to order.

The papers printed in this number were read or presented and discussion was begun of the papers read at the last meeting of the Society.

The Society then adjourned for dinner at 7:30 P.M. at the Hotel Astor. The after-dinner speakers were:

Hon. Jesse S. Phillips, Superintendent of Insurance, State of New York.

Hon. Burton Mansfield, Insurance Commissioner, State of Connecticut.

Hon. James V. Barry, Assistant Secretary, Metropolitan Life Insurance Company.

The following Fellows of the Society also spoke:

Messrs. Blanchard, McManus and Moir.

The Society reconvened on November 1, at 10:30 A.M., with Vice-President Ryan in the chair.

The discussion of the papers read at the last meeting of the Society was resumed.

Upon motion the meeting adjourned at 1:15 P.M.

CONSTITUTION.

(As Amended October 27, 1916.)

Article I.—*Name.* This organization shall be called The Casualty Actuarial and Statistical Society of America.

Article II.—*Object.* The object of the Society shall be the promotion of actuarial and statistical science as applied to the problems of casualty and social insurance by means of personal intercourse, the presentation and discussion of appropriate papers, the collection of a library and such other means as may be found desirable.

The Society shall take no partisan attitude, by resolution or otherwise, upon any question relating to casualty or social insurance.

Article III.—*Membership.* The membership of the Society shall be composed of two classes, Fellows and Associates. Fellows only shall be eligible to office or have the right to vote.

The Fellows of the Society shall be the present members and those who may be duly admitted to Fellowship as hereinafter provided. Any Associate of the Society may apply to the Council for admission to Fellowship. If his or her application shall be approved by the Council with not more than one negative vote he or she shall become a Fellow on passing such final examination as the Council may prescribe. Otherwise no one shall be admitted as a Fellow unless recommended by a duly called meeting of the Council with not more than one negative vote followed by a ballot of the Society with not more than four negative votes and not less than twenty affirmative votes.

Any person may, upon nomination to the Council by two Fellows of the Society and approval by the Council of such nomination with not more than one negative vote, become enrolled as an Associate of the Society provided that he shall pass such examination as the Council may prescribe.

Article IV.—*Officers and Council.* The officers of the Society shall be a President, two Vice-Presidents, a Secretary-Treasurer, an Editor, and a Librarian. The officers with ex-Presidents, ex-Vice-Presidents and four other Fellows shall constitute the Council.

Article V.—*Election of Officers and Council.* The officers shall be elected by a majority ballot at the annual meeting for the term of one year and two members of the Council shall, in a similar manner, be annually elected to serve for two years. The President and Vice-Presidents shall not be eligible for the same office for more than two consecutive years nor shall any retiring member of the Council be eligible for re-election at the same meeting.

ARTICLE VI.—*Duties of Officers and Council.* The duties of the officers shall be such as usually appertain to their respective offices or may be specified in the by-laws. The duties of the Council shall be to pass upon candidates for membership, to decide upon papers offered for reading at the meetings, to supervise the examination of candidates and prescribe fees therefor, to call meetings, and, in general, through the appointment of committees and otherwise, to manage the affairs of the Society.

ARTICLE VII.—*Meetings.* There shall be an annual meeting of the Society on such date in the month of October as may be fixed by the Council in each year, but other meetings may be called by the Council from time to time and shall be called by the President at any time upon the written request of ten Fellows. At least two weeks notice of all meetings shall be given by the Secretary.

ARTICLE VIII.—*Quorum.* A majority, or seven members, of the Council shall constitute a quorum. Twenty Fellows of the Society shall constitute a quorum.

ARTICLE IX.—*Expulsion or Suspension of Members.* Except for non-payment of dues no member of the Society shall be expelled or suspended save upon action by the Council with not more than one negative vote followed by a two-thirds ballot of the Fellows present and voting at a meeting of the Society.

ARTICLE X.—*Amendments.* This constitution may be amended by an affirmative vote of two-thirds of the Fellows present at any meeting held at least one month after notice of such proposed amendment shall have been sent to each Fellow by the Secretary.

BY-LAWS.

(AS AMENDED OCTOBER 27, 1916.)

ARTICLE I.—*Order of Business.* At a meeting of the Society the following order of business shall be observed unless the Society votes otherwise for the time being:

1. Calling of the roll.
2. Address or remarks by the President.
3. Minutes of the last meeting.
4. Report by the Council on business transacted by it since the last meeting of the Society.
5. New membership.
6. Reports of officers and committees.
7. Election of officers and Council (at annual meetings only).
8. Unfinished business.
9. New business.
10. Reading of papers.
11. Discussion of papers.

ARTICLE II.—*Council Meetings.* Meetings of the Council shall be called whenever the President or three members of the Council so request, but not without sending notice to each member of the

Council seven or more days before the time appointed. Such notice shall state the objects intended to be brought before the meeting, and should other matter be passed upon, any member of the Council shall have the right to re-open the question at the next meeting.

ARTICLE III.—*Duties of Officers.* The President, or, in his absence, one of the Vice-Presidents, shall preside at meetings of the Society and of the Council. At the Society meetings the presiding officer shall vote only in case of a tie, but at the Council meetings he may vote in all cases.

The Secretary-Treasurer shall keep a full and accurate record of the proceedings at the meetings of the Society and of the Council, send out calls for the said meetings, and, with the approval of the President and Council, carry on the correspondence of the Society. Subject to the direction of the Council, he shall have immediate charge of the office and archives of the Society.

The Secretary-Treasurer shall also send out calls for annual dues and acknowledge receipt of same; pay all bills approved by the President for expenditures authorized by the Council of the Society; keep a detailed account of all receipts and expenditures, and present an abstract of the same at the annual meetings, after it has been audited by a committee of the Council.

The Editor shall, under the general supervision of the Council, have charge of all matters connected with editing and printing the Society's publications. The *Proceedings* shall contain only the proceedings of the meetings, original papers or reviews written by members, discussions on said papers and other matter expressly authorized by the Council.

The Librarian shall, under the general supervision of the Council, have charge of the books, pamphlets, manuscripts and other literary or scientific material collected by the Society.

ARTICLE IV.—*Dues.* The dues shall be ten dollars for Fellows and five dollars for Associates payable upon entrance and at each annual meeting thereafter, except in the case of Fellows not residing in the United States, Canada, or Mexico, who shall pay five dollars at the times stated.

It shall be the duty of the Secretary-Treasurer to notify by mail any Fellow or Associate whose dues may be six months in arrears, and to accompany such notice by a copy of this article. If such Fellow or Associate shall fail to pay his dues within three months from the date of mailing such notice, his name shall be stricken from the rolls, and he shall thereupon cease to be a Fellow or Associate of the Society. He may, however, be reinstated by vote of the Council, and upon payment of arrears of dues.

ARTICLE V.—*Amendments.* These by-laws may be amended by an affirmative vote of two-thirds of the Fellows present at any meeting held at least one month after notice of the proposed amendment shall have been sent to each Fellow by the Secretary.

RULES REGARDING EXAMINATIONS FOR ADMISSION TO THE SOCIETY.

The Council adopted on March 29, 1915, the following rules providing for the examination system of the Society:

1. Examinations will be held on the first Wednesday and Thursday during the month of May in each year in such cities as will be convenient for three or more candidates.

2. Application for admission to examination should be made on the Society's blank form, which may be obtained from the Secretary-Treasurer. No applications will be considered unless received before the fifteenth day of March preceding the dates of examination.

3. A fee of $5.00 will be charged for admission to examination. This fee is the same whether the candidate sits for one or two parts and is payable for each year in which the candidate presents himself. Examination fees are payable to the Secretary-Treasurer and must be in his hands before the fifteenth day of March preceding the dates of examination.

4. The examination for Associateship consists of four parts. Not more than two parts can be taken in the same year and no credit will be given for the passing of any part unless all previous parts have been passed during the same or previous years.

5. In the case of applicants not less than thirty years of age, who have had not less than five years' experience in actuarial or statistical work in insurance offices, the Council may, upon receipt of satisfactory evidence of general education, waive the passing of Parts I, II and III of the Associateship examination. Such applicants may thereupon become Associates by passing Part IV of the Associateship examination.

6. Admission to Fellowship examinations is granted only to those who are Associates of the Society. The examination for Fellowship is divided into two parts. No candidate will be permitted to present himself for Part II unless he has previously passed in Part I or takes Parts I and II in the same year. If a candidate takes both parts in the same year and passes in one and fails in the other, he will be given credit for the part passed.

7. As an alternative to the passing of Part II of the Fellowship examination, a candidate may elect to present an original thesis on an approved subject relating to casualty or social insurance. Candidates electing this alternative should communicate with the Secretary-Treasurer as to the approval of the subject chosen. All theses must be in the hands of the Secretary-Treasurer before the first Thursday in May of the year in which they are to be considered. Where Part I of the Fellowship examination is not taken during

the same year, no examination fee will be required in connection with the presentation of a thesis. All theses submitted are, if accepted, to be the property of the Society and may, with the approval of the Council, be printed in the *Proceedings*.

8. In Part II of the Fellowship examination the papers will be so arranged that it will be necessary for the candidate to write on only three of the four prescribed topics in order to obtain full credit.

9. *Special attention is called to the following important exception to the above rules effective as respects the year 1918.* Examinations will be regularly held in May, 1918, but in the case of candidates for Associateship presenting themselves at that time the passing of Parts I and II will be waived and the candidates will be required to take Parts III and IV only. Commencing with 1919, candidates for Associateship will be expected to pass in all four Parts of the Syllabus.

Syllabus of Examinations.

For Enrollment as Associate.

Part I:

1. Elementary algebra up to and including the binomial theorem.
2. Elementary plane trigonometry including the use of logarithms.
3. Elementary plane analytical geometry.
4. Double entry bookkeeping.

Part II:

1. Advanced algebra.
2. Elementary differential and integral calculus.
3. Elementary calculus of finite differences.
4. Theory of probability and least squares.

Part III:

1. Compound interest and annuities-certain.
2. Theory of statistics.
3. Elements of the theory of life annuities and assurances, including the calculation of premiums and reserves for the simpler forms of policy.
4. Elements of economics.

Part IV:

1. Practical problems in statistics.
2. Policy forms and underwriting practice in casualty insurance, viz.: Personal accident, health, liability, workmen's compensation, fidelity, surety, plate glass, steam boiler, burglary, fly wheel, automobile, workmen's collective, credit.
3. Practical problems in insurance accounting and statistics, including the preparation of annual statements.
4. Insurance law, including the more important statutes of the United States and Canada relating to casualty insurance.

For Admission as Fellow.

Part I:

1. Calculation of premiums and reserves for accident, sickness, workmen's compensation and other branches of casualty insurance.
2. Inspection of risks; adjustment and settlement of claims.
3. Investments of insurance companies.
4. Current problems in workmen's compensation and other branches of casualty insurance.

Part II:

1. Principles and history of social insurance.
2. Compilation and use of census or other government statistics relating to population, mortality, invalidity, sickness, unemployment, old age and allied matters.
3. Systems of invalidity, old age and unemployment insurance.
4. Calculation of premiums for and valuation of pension funds.

A copy of a pamphlet entitled "Recommendations for Study in Connection with the Examinations of the Casualty Actuarial and Statistical Society of America" may be obtained upon application to the Secretary.

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THE EXPERIENCE RATING OF WORKMEN'S COMPENSATION RISKS. Joseph H. Woodward.

VALUATION OF PENSION FUNDS, WITH SPECIAL REFERENCE TO THE WORK OF THE NEW YORK CITY PENSION COMMISSION. George B. Buck.

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

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PROCEEDINGS

OF

The Casualty Actuarial and Statistical Society of America

MAY 20 AND 21, 1918

SUBSCRIPTIONS TO THE PROCEEDINGS

Volume I consists of Numbers 1, 2 and 3, price $3.00.

Volume II consists of Numbers 4, 5 and 6, price $3.00.

Volume III consists of Numbers 7 and 8, price $2.00.

Volume IV consists of Numbers 9 and 10, price $2.00.

The above volumes are bound in buckram. Any number may be purchased at $1.00 per copy. The subscription rate for Volume V, which will consist of Numbers 11 and 12, is $2.00.

Communications should be addressed to

RICHARD FONDILLER, *Editor,*

CASUALTY ACTUARIAL AND STATISTICAL SOCIETY,
230 FIFTH AVENUE, NEW YORK.

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VOLUME IV, PART II. NUMBER 10.

PROCEEDINGS

MAY 20 and 21, 1918.

ECONOMIC PROBLEMS OF THE WORLD WAR.

ADDRESS OF THE PRESIDENT, JAMES D. CRAIG.

The problems of economics are of interest to the members of this Society. The subject is among those required to be studied in preparing for our examinations, and even in our last examination it was required to distinguish between economic and social problems. The economic problems are those pertaining to economics, which is the science which treats of the production and distribution of wealth, while the social problems are those pertaining to the relation of persons as living in society or to the public as an aggregate body. The nation is now passing through a period in which large problems are being presented, while the federal government is becoming increasingly active in supervising the production and distribution of wealth. It has therefore seemed appropriate that some of the events which pass before us in kaleidoscopic form and which consequently are apt to escape notice, be brought to your attention.

It is doubtful if ever before any one thing has been of such vital importance at one time to so many people as this war. From a pamphlet, published by the Bankers Trust Company, entitled "The Balance Sheet of the Nations at War," we have the following figures:

	Population.	Army and Navy, Estimated Strength.
Entente Allies (including Russia) and United States	473,250,000	21,400,000
Teutonic Allies	147,000,000	11,000,000
	620,250,000	32,400,000

	Casualties within Three Years.			
	Killed.	Seriously Wounded.	Captured or Missing.	Total.
Entente Allies (including Russia) and United States	4,207,956	2,444,968	2,340,032	8,992,956
Teutonic Allies.....	2,925,136	1,744,509	1,632,128	6,301,773
	7,133,092	4,189,477	3,972,160	15,294,729

In addition, Mrs. Inez Haynes Irwin, wife of Will Irwin, the war correspondent, speaking at the Washington headquarters of the National Women's Party on "Women in the War Zone," stated that from 500,000 to 750,000 women have been killed in the war. According to the *New York Times* of May 14, Mrs. Irwin is quoted as saying:

"These women owe their deaths to causes connected directly with the war. They have been killed in munition factories, have met with accidents directly behind the French and British lines, have been killed by submarines, by bombs, and by other causes. This is the first war in which women have been mobilized as a sex behind their men in the fight, and the first time, therefore, they have been exposed to such risks."

When 600,000,000 people are involved in a death struggle and when over 15,000,000 men have been either killed, wounded or captured in three years, we must surely take cognizance from the economic viewpoint of the phenomena through which we are passing. Economics treats of the man for whom wealth is produced, considers him in the enjoyment of this wealth in society at large, studies him in the presence of development and contemplates the ever-changing laws which govern his very existence, and now a large proportion of the population of the world has formed itself into one society and is concentrating all its energies in the production of goods for man's freedom and for the perpetuation of civilized international law.

While the goods now being produced are intended chiefly for destructive purposes, the ultimate object is the welfare of man. If it is one of the commonest retrogressions in human experience to become rich in goods, while at the same time lose power to profit by them, then conversely, power to profit may be gained through the destruction of goods.

The present struggle centers around the freedom and well-being

of man, and this country, as well as its allies, is concentrating all its productive power in order to accomplish this one result. In the natural course of human development, many legislatures have found it expedient to place more and more the general control of public utilities in the hands of the government, but in this crisis we are experiencing, without any objection and, in fact willingly, consent to all such radical movements as the appointment of a Food Administrator with wheatless and meatless days, and with regulation of the baking industry; a Fuel Administrator with heatless Mondays and coal cards; advancing of the clock one hour during the summer; a government curtailment of non-essential industries; regulation not only of exports, but of re-exports; regulation of both wages and prices, as in the coal and copper industries. Further than this, where regulation does not serve the best purpose, the industries have been completely absorbed and managed by the government, as, for instance, the taking over of the railroads and such industries as acetone and lime, wood alcohol, etc.

With all these activities passing into the control of the government, the phenomena have developed even further in that full authority to regulate, organize and reorganize has been requested by the President and to a great extent been vested in him by Congress, at least for the period of the war and a short time thereafter. Whether or not the economist of the future will concur as to the expediency of the present-day development or whether or not the conclusion of the war will bring a reaction remains to be seen, but there is no doubt that all of the phases of economics are at present in a very much changed condition. The government to-day has a monopoly on many things. It controls to a greater extent than ever the production of goods, as well as the consumption. It establishes the price of materials. It governs the financial situation and has even gone into the life insurance and compensation business.

The laissez-faire doctrine of the old economy has been superseded by the National Security and Defense Act of August, 1917, not only for production, sale and consumption, but for sumptuary affairs. Habits and manners of life can now be regulated. Nocturnal amusements are vetoed by ordering off the lights, menus are regulated from coast to coast, and prohibition ordered where local option has said "Yes," to alcohol. It would be hard to study the general question of economics and find any subject in which the government has not revolutionized past conceptions.

As regards production, Mr. Frank A. Vanderlip, chairman of the

National War Savings Committee, in advocating the purchase of War Savings Certificates, argued not so much for the actual cash thus made available, but that every dollar so invested was automatically withheld from the purchase of unnecessary articles and that if these articles were not purchased, they would not be manufactured and the labor necessary for their manufacture would consequently be released for the manufacture of essentials. Thus, it is manufactured articles, rather than money, that are really desired. He stated emphatically that the government faced a shortage of men and material, rather than of money, and that while every dollar of capital saved and accumulated is useful to the community, every idle or incompetent man represents a continuing loss as compared with an industrious and efficient man. New Jersey, Maryland, West Virginia and New York have recently passed laws compelling certain hours of work each week from every able-bodied man between the ages of eighteen and fifty, while Georgia, Florida and other states are moving toward the same legislation. If the war lasts much longer, this labor condition may be further aggravated. Our total army is not within striking distance of the losses of either the Teutonic Allies or of the Entente Allies and yet we are strained for men and material.

These radical changes have all been adopted in the interest of winning the war and the reason they have been made so rapidly was the necessity for mobilizing the entire country as quickly as possible. We were absolutely unprepared for the war. Farseeing citizens have been advocating compulsory military service for a number of years, but owing to the natural antipathy to giving the country up to military pursuits, no headway had been made. For years publicists had been urging upon Congress the importance of subsidizing shipping, in order that a merchant marine might be built, but despite the example set by England, Japan and Germany, our legislative bodies at Washington could not or would not see the advisability of it. To-day one portion of the nation is competing with another as to which can build boats the quicker, with the result that 5,500-ton steel boats are being put in commission thirty-seven days after the laying of their keels, while wooden boats are being launched every day.

The general short-sightedness of our policy of penalizing the railroads had brought them to a starving condition, with no latent power to take care of the extra burdens imposed upon them. Legislation and commissions seemed to feel that the railroads were in the

hands of bankers and capitalists who would profit by an increase in rates, despite the fact that President Wilson in his address to Congress, respecting the taking over of the railroads, stated that there were some ten or eleven million small investors in the country interested in them. To-day locomotives are being used which were originally intended for Russia. Additional freight cars have been ordered by the thousands and tens of thousands, while the wage increase will exceed a quarter of a billion dollars. When the crisis came, the country was compelled to concentrate all its energies to accomplish in a relatively short time what certain of the other nations had taken years to perfect.

Mr. John B. Lunger, Vice-President of the Equitable Life Assurance Society, in an address before the Chamber of Commerce, Cleveland, Ohio, on February 5, 1918, stated:

"Ten years before the war Germany's scheme of mobilization was explained to me in Munich and I was given an insight into her system of keeping up her stores of supplies. Except in the matter of finance she was as ready then for war as she was in 1914."

Generally, the same conditions applied in England as in the United States and the same mobilization of industries was largely effected under the Defense of the Realm Act. When the war changed the economic conditions, the government, in order to prosecute it more vigorously, undertook a new interest in business activities which necessitated greatly extending its financial credits. Just how far they had been extended through 1916 is shown below, but to what extent they will be extended before the war is over is apparently beyond conjecture. In a book entitled "The Effect of Wars and Revolutions on Government Securities," by Mr. E. Kerr, there are some interesting statistics and from this we can quote the estimated population, estimated wealth and debt at the end of 1914 in certain of the countries, together with the debt at the end of 1916, and these figures herewith follow:

SCHEDULE SHOWING COMPARATIVE DEBT OF DIFFERENT COUNTRIES.

	Estimated Population.	1914, Estimated Wealth.	1914, Debt.	1916, Debt.
Great Britain .	45,663,000	$ 86,400,000,000	$3,479,070,854	$17,336,000,000
France	39,660,000	62,400,000,000	6,343,622,400	18,005,000,000
Russia	167,920,000	40,000,000,000	4,538,654,400	7,161,000,000
Japan	52,985,423	9,749,040,000	1,251,316,800	1,234,000,000
United States.	95,411,000	187,739,071,090	1,027,574,697	1,132,639,195
Germany	66,146,000	76,800,000,000	4,538,654,400	16,978,000,000

In the "Balance Sheet of the Nations at War," previously quoted, the Bankers Trust Company gives these data subdivided in detail. The pamphlet includes the figures for Russia, but these are here excluded.

SCHEDULE SHOWING CERTAIN DATA OF THE WARRING COUNTRIES.

	Population.	National Wealth.	National Debt.
Entente Allies including the United States	303,250,000	$495,000,000,000	$59,960,000,000
Teutonic Allies	147,000,000	134,000,000,000	38,500,000,000

	National Income.	Cost of War for Three Years.
Entente Allies including the United States	$72,100,000,000	$49,700,000,000
Teutonic Allies	16,600,000,000	39,300,000,000

While the complete figures for 1917 have not been compiled as yet, Herr Havenstein (President of the German Imperial Bank), in speaking for the seventh German War Loan during the latter part of 1917, put the total cost of the war to date at £22,500,000,000 and says that Germany and her allies bear one-third, while the other two-thirds fall upon Germany's enemies—the lion's share upon England. England's expenditure he says, "both including and excluding advances to her allies, was far greater than Germany's expenditure, and was also increasing more rapidly. England, 'in spite of, or perhaps precisely because of, the very great energy with which she had increased taxation, now perhaps up to the limit of the tolerable,' had only put two-fifths of her war expenditure into fixed loans, while Germany, including the new loan, would have consolidated seven-ninths or eight-ninths of her war debt."

With the entrance of the United States into the war in 1917, it it only natural that her debt should begin to increase. During the first year two Liberty Loan Bond Issues were sold to the extent of $5,808,766,150. The first loan was for $2,000,000,000 and the second for $3,000,000,000, with the proviso that one-half of the over-subscriptions would be taken. As the loan was over-subscribed $1,617,532,300, the amount allowed was $3,808,766,150. We have now been through the third Liberty Loan Campaign, which was for $3,000,000,000, with the right to accept all over-subscriptions. The figures just issued by the Treasury Department show

that the subscriptions exceeded $4,100,000,000. An interesting feature of this war is the issuance of obligations in very small denominations, such as War Savings Stamps and Certificates, from which it is hoped the income of the country for the year will be increased over $1,500,000,000. It is therefore apparent that the increase in indebtedness of the United States for the year is greater than that of any one of the other countries.

This country is following the practice of England of financing the war partly from taxation, instead of exclusively from bonds, as this is generally recognized by conservative men to be better business and great increases have consequently been made in the various tax rates. In preparing the latest tax bill, it was thought that a little less than $3,000,000,000 would be obtained in one year under its terms, but the indications now are that the amount will greatly exceed this, some estimates going as high as $4,000,000,000 or $5,000,000,000.

One special feature, which is worthy of attention as manifested through both the tax returns and subscriptions to the Liberty Bonds, is the changing conditions among our wealth producers. According to the *New York Times* of April 4, Collector Eisner, of the Third Internal Revenue District of New York, stated:

"A casual inspection of the returns will be of considerable interest to an economist studying the changes wrought by the war. Old established firms, corporations and individuals, where wealth in the past has been concentrated, showed considerable falling off in income and the losses sustained by many who have been charged by demagogues and anarchists with having urged the war, not for principle, but for their own pockets, furnish ample refutation of any such charge.

"Many small industrial concerns not engaged in war business showed largely increased profits, and on the surface it would seem that the war is causing a redistribution of wealth, which is now being accumulated, not upon the basis of fixed investments, but upon the basis of actual active production.

"In other words, those who in the past have lived on their incomes derived from investments are suffering, whereas those who are to-day actively producing goods are accumulating wealth in which the Government participates, which is as it should be because the war will be won by production and not by money."

There are a large number of people whose resources, either through productivity or otherwise, are sufficient to enable them to manifest their interest by buying government investments, as, ac-

cording to Secretary McAdoo, 9,400,000 men and women subscribed to the second Liberty Loan and 99 per cent. of all the subscriptions were from $50 to $50,000. For the third loan there were approximately 17,000,000 subscribers.

The general change in the value in productivity of goods in England is made manifest by a study of the trend of 387 representative securities, as given by the *Bankers' Magazine* of London. These securities showed a decline in value during 1917 of £158,000,000. It is interesting to note that this was more than caused by a decline of £160,000,000 in the value of American securities, which is ascribed to America's entry into the war and her flotation of over £1,000,000,000 in loans. Some securities showed considerable increase, especially in the industrial section. Brewery stocks, for example, have risen by no less than 41 per cent., electric lighting and power by 15½ per cent., canals and docks by 14 per cent., insurance shares by 14½ per cent., and shipping shares by 8¾ per cent. English and colonial railway stocks have declined severely, while in the mining department movements have been slight, and apart from copper shares, which are rather higher, the changes are adverse.

In addition to all its other financing, the United States has loaned over $5,000,000,000 to the Allies in twelve months. Naturally, with all this government financing, the general business of the country has experienced difficulties in its regular finance. Thus, while industrial corporations offered $400,000,000 in bonds and note issues during the first three months of 1917, the similar offerings this year have been about $270,000,000.

To somewhat alleviate the difficulties experienced by private business, the government has formed the War Finance Corporation, with power to extend needed assistance to almost any class of railroad, industrial or banking corporations, as well as to any individuals. This corporation can issue its own bonds, maturing in not less than one or more than five years and bearing such rates of interest as its directors shall determine, with the approval of the Secretary of the Treasury, and these bonds may be payable in any foreign money. The corporation has been created as a distinctly war issue and six months after the war ends shall cease to exercise any of its powers, except such as are incidental to the liquidation and winding up of its affairs.

It is gratifying to note that through all these changes insurance

in all its phases has fulfilled its function, in so far as it was permitted, with remarkable success. Mr. Frank Lock, United States Manager of the Atlas Assurance Company of London, in the *Journal of Commerce* of January 2, stated that the fire insurance business has increased by leaps and bounds until last year the income aggregated $350,000,000 and the losses approximately $270,000,000, which were the worst ever recorded for one not marked by serious conflagration. Losses and expenses will probably continue to increase on account of the war conditions, while, in addition, all miscellaneous insurance allied to fire insurance will show great activities and the carrying capacity of companies will be tested to the utmost. The casualty companies, on account of greater experience, have been able to assess the costs in such manner that they could meet the excess cost, and, despite the war conditions, have experienced a most satisfactory year, while for life insurance the year probably saw more insurance written than any year in the history of the business.

While it is too early to talk about peace, all thoughtful men are considering how long the nations can continue incurring such obligations and what will be the effect after the war. How far the nations can go, it is impossible to state. Some time ago Herr Havenstein declared that Germany would not be bankrupt until her indebtedness amounted to 100,000,000,000 marks. How this figure was arrived at we do not know, but from the figures previously quoted, it is evident that this sum has already been exceeded. If the indebtedness was figured according to the amount on which interest could be paid, either from the natural increase in wealth or from the total wealth, it may be that bankruptcy will follow later. Herr George Bernhard, editor of the *Vossische Zeitung,* is reported to have recently declared that Germany's indebtedness at the end of the war will be 150,000,000,000 marks and he estimated the Empire's national wealth to be 400,000,000,000 marks.

The figures previously given show that at the end of 1916 the French debt was a larger proportion of the estimated wealth at the end of 1914 than was the case in Germany, while the percentage for Great Britain was slightly smaller. The introduction of the United States into the war completely changed the total credits available, as according to the figures already given it made the estimated wealth of Great Britain, France and the United States over four times that of Germany, so that the 1916 debt could be doubled before the proportion would equal that of Germany.

C. F. Childs and Company, of Chicago, have just published a "Summarization of the Economic Data bearing upon the Third Liberty Loan." In this pamphlet appears the following:

"It is a fact usually overlooked that the property values of this nation have increased to a marked degree since we entered the war. A conservative appraisal of the economic wealth of the United States may be reasonably figured at close to $300,000,000,000. Our estimated annual national income is about $50,000,000,000."

If Herr Bernhard's statement is correct, namely, that Germany's debt will be 150,000,000,000 marks when the war is over, then the end of the war is in sight. It would seem as though this were all the debt that Germany could carry, in fact, more than she could carry, but according to Francis Vinton Greene, in the Magazine Section of the *New York Times* of April 7:

"The importance of finance in a war is exaggerated. It is essential, it is indispensable, if a nation is to remain solvent. But when nations become involved in a death grapple, they do not stop at insolvency. Frederick debased the currency, other nations have used the printing press. When credit is so hopelessly gone that it it not worth while to print any more paper, then nations (if they are really in earnest) go on without any money, as we did from 1780 to 1783 and as the South did in the last six months of the Civil War."

In this connection, however, it is interesting to note that Mr. Arne Fisher, in *The Economic World* of September 1, 1917, in discussing German life insurance companies, states:

"Many companies, among which may be mentioned the famous old Gotha Life, have, under the cover of patriotic motives, tried to unload some of their war securities on unsuspecting policyholders by declaring themselves willing for the sake of the Fatherland to pay matured claims in war bonds instead of in cash."

Mr. Fisher tells us that according to the annual report of the Gotha Life Insurance Company, this company recently attempted without success to purchase a large block of Swiss and Danish Government Loans. Apparently, the German life insurance companies are not manifesting much confidence in the bonds of their own government. In the *New York Times,* of May 10, it is stated that American money is desired for the purchase of this year's crop from the Ukraine, as the Russians refused to accept payment in German or Austrian notes on account of their great depreciation.

Some thought is now being given to conditions as they will exist when this war is over. Will any of the nations be living without money before it is over or will bankruptcy prevail at the end? Mr. Kerr, in his book before referred to, tells us:

"There are very few occasions on which the interest on the bonds of responsible governments has been defaulted, repudiated or funded."

After a war there usually follows a period of expansion and invention in the defeated, as well as in the victorious, country. Practically all the debts of the modern nations are dated from the Napoleonic Wars and have been accompanied with enormous changes. While the British debt was looked upon as of considerable magnitude at the end of those wars, it was never wholly liquidated and at the beginning of this war was about three quarters as large as of that time, but the wealth of the country has increased to such an extent that the debt was relatively a much smaller consideration. Present conditions are without precedence, either as to size or scope and method of destruction, making it hard to foretell its effects, but from past wars some possibility may be observed.

To quote Mr. Kerr again:

"The results should be larger; the debts will be greater, but the expansion and stimulation of energies that will follow will also be greater."

The world's supply of gold is estimated at $8,500,000,000 and with greater expansion and stimulation of energy we may have to vary our standards. The finance of international trade may be destined to proceed along new and divergent lines. Improvements must continue. Locomotives now pull one hundred cars carrying fifty tons each to the train, instead of twenty-five cars of thirty tons each, as formerly, and with the aid of electricity trains of even greater length may be run. The world is not being destroyed. France, Belgium, Serbia, Roumania, parts of Austria and Russia have suffered severely. The loss to ocean shipping, though considerable, has been distributed by insurance upon all the trades of the world and is being paid for as we go. The industrial plants of the world are continually being torn down and replaced by the new, while the clothes we wear are still manufactured and the food we eat is still produced. We are to a certain extent marking time, but once the war is terminated the forward procession will go on.

This may not occur immediately but the idea expressed by Mr. Vanderlip that we need men and material means production and what this country and all countries will need after the was is production. We ought to have it indelibly impressed upon our minds that production is the thing for which we are responsible and that an increase in the national income will do more to offset discontent than will radical legislation or large political movements.

Foreign trade after this war will undoubtedly present a large opportunity for some of our insurance companies, particularly marine and fire. According to Mr. Henry Evans, as appearing in the *Journal of Commerce* of November 8, 1917:

"After the war the United States will probably be the largest creditor nation, possessing the greatest resources in immediate sight for conversion and realization, and for the first time in more than half a century will have in hand a merchant shipping sufficiently large to enable American business interest to carry in its own bottoms much of the vast commerce that will be immediately released for the rehabilitation of the exhausted nations."

In this article Mr. Evans shows how banking, shipping and insurance must go hand in hand, as, for instance, in Germany, where the banking, shipping and insurance were all backed by the Imperial Government, and in Great Britain, where the government at home was backed by the great banking, shipping and insurance interests in every trading port of the world. Japan is planning to follow the German method.

If some nation must always be dominantly the arbiter of international requirements, as Great Britain has been for more than a hundred years, it is suggested by Mr. Evans that now is the time for the United States to begin to forge to the front by having its insurance extended, so that it may co-operate fully with the banking and shipping interests of the country and so stand in back of the industries that will be induced to press forward.

An interesting aspect of the general future activities of the country can be observed by a comparison of the increase in insurance now being issued with the increase in the days of the Civil War. Mr. Philip Burnet, president of the Continental Life Insurance Company of Wilmington, Del., in an article, in the *Life Insurance Courant* of May 2, 1918, entitled "A Striking Parallel," states:

"When the European War started in 1914, who could have pre-

dicted that its effect on life insurance in the United States would be much the same as the Civil War, when life insurance made such giant strides?

"A chart of comparison discloses a striking parallel. It shows a decrease in new insurance during the first year of each of the two wars, followed by a remarkable increase thereafter."

He then gives the figures in the following table:

TABLE SHOWING NEW LIFE INSURANCE ISSUED IN EACH YEAR FROM 1860–1864 AND FROM 1913–1917, TOGETHER WITH THE INCREASE OVER THE PREVIOUS YEAR.

Year.	New Life Insurance.	Increase.
1860	$35,589,934	
1861	24,978,444	—$10,611,490
1862	43,471,429	18,492,985
1863	89,812,093	46,340,664
1864	155,803,897	65,991,804
1913	2,549,816,531	
1914	2,456,548,936	—93,267,595
1915	2,621,013,624	165,464,688
1916	3,213,091,791	592,078,167
1917	*4,000,000,000	*800,000,000

Mr. Burnet stated that the increase did not stop with the close of the war, but went on increasing for four years thereafter and then a steep decline commenced, which continued for nine years, after which it again mounted steadily year by year, except for short periods. If the history of life insurance is any guide, and it has repeated itself in the first few years, are we now moving to greater fields of activity and to greater expansion and stimulation of energy.

The casualty and surety premiums in this country will soon amount to $300,000,000 a year. The energy of the future will still be applied to create more power and a more varied and abundant existence, all of which will increase the hazards of life and impose new burdens on the casualty business. Even as late as May 13, the New York Workmen's Compensation Law was extended to cover numerous employments not previously included.

When we consider these changes and attempt to look into the future it becomes evident that progress and advancement must con-

* Approximated.

tinue; the war will leave Europe in the position of a new country, poor in immediate comforts but relatively rich in future expectations, and she will have to pay a relatively high rate of interest for such advances as are made to her. The present conditions are the result of man's inhumanity to man. This is what caused the war. It had previously caused the great distrust which certain groups of people felt toward others and which among other things ultimately led to the starving condition of the railroads. Have we an awakened conscience which can proceed with an accelerated economic development? Can the feeling of suspicion and distrust, one for the other, be smothered in the enlarged feeling for humanity? With all working in harmony for one set purpose, an inspiring future, both economic and social, is before us, but, as John Oxenham has so aptly expressed it,

> If we would build and build to stay,
> We must find God and go His way.

A New Criterion of Adequacy of Exposure.

BY

ALBERT H. MOWBRAY.

Except in a few unusual lines of industry compensation insurance rates must for a long time in the future be based upon a minimum of data supplemented by expert judgment. This must be so for at the present time there are some 1,400 classifications in the workmen's compensation rate manual. We may look forward to changes from time to time in the phraseology of the classifications and the elimination of some existing classifications. I doubt if we can look forward to any material reduction in the total number. We must allow a certain time to elapse for the collection of our statistical data, yet so rapid is the flux and change of conditions we must measure and deal with, that we can not give much credence for future rate-making to data of even a very few years back.

This combination of conditions requires that we make the best possible use of every scrap of data we have, skilfully combining it with others as we find ourselves justified, and modifying its indications for rate-making where our judgment points out the need of so doing. Under such circumstances grouping of classifications for rate-making purposes and judgment of modification of experience indications before acceptance seem inevitable. Any extension of a group, however, to include data from an additional classification, even though pure premiums be made separately for the several parts of the hazard, breaks down to that extent the homogeneity of the group and, therefore, the applicability of its indication for all the classifications in the group. Hence the greatest skill and care is necessary in such work.

Generally speaking, the grouping of classifications is to give an increased spread of experience, though it may be in certain instances for the purpose of determining rates for some of the less important classifications by linking them up with a more important one in which there has been a large exposure.

Judgment is resorted to to correct apparent aberrations. These may be of two kinds,

1. Those due to a volume of statistical data insufficient to overcome the influence of pure chance.

2. Those due to persistent disturbing factors, such as the presence of a particular risk or risks of large size, which are distinctly better or worse than the true class type or average, a change in general industrial conditions, etc.

The proper correction of the latter type of cases is further analysis of the data so as to present homogeneous material and/or its modification to measure and allow for the differences in conditions of the past and future so far as known. This further analysis may so reduce the data as to introduce aberrations of the first type which may or may not be recognized as such.

It would seem there could be a substantial reduction in the need for judgment modification of experience indications if the hazards covered by the premium be segregated and separately measured. The big variations in indication arise from the hazards of low probability but high cost, such as death and permanent disability both total and partial. It may well be that we are fully justified in a much wider grouping basis for these elements than for those of high probability and low cost, such as medical expense. But even here we do not wish to extend our groupings too widely. There are many reasons why we may wish to confine them as closely as may be and give us a sufficient spread to give reasonably dependable indications. We need then a satisfactory criterion of exposure necessary to give such indications.

Back of this, of course, we must say what is a dependable indication. It would appear that this definition must be expressed in the form of a probability that the indication is within a certain fixed percentage of the true value. The definition in this form involves two free constants.

At the organization meeting of this Society, the writer presented a tentative solution which will be found in the *Proceedings,* Vol. I, p. 24. This solution was based upon two assumptions:

1. That the probability of hazard remained constant (or approximately constant) throughout the period observed so as to give a Bernoullian distribution of occurrences, and,
2. That over the critical region the normal frequency curve (Gauss's error curve) fitted the Bernoullian dispersion with a sufficiently close approximation to permit its use in place thereof.

Neither of these assumptions are fully realized in actual practise. But after due allowance and correction has been made for disturbing factors (such as for "increasing cost," "industrial activity," and other items considered at the last rate conference) the first may perhaps be taken as approximately true. Indeed, its approximate truth when so corrected seems to be a fundamental requirement of prospective rate-making. If this is so then we may properly approach the problem of the dependability of our data by first examining the conditions under which it was produced and making correction for general disturbing influences, and then determining from appropriate criteria its probable freedom for error due to lack of spread. Recently I have found a way to attack this latter problem without resorting to the second and more questionable assumption above cited. The method rests upon a theorem of Tchebycheff cited by Arne Fisher in his "Mathematical Theory of Probabilities," Vol. I, p. 108.

After pointing out the practical uselessness of the much discussed most probable value of a series of trials of an experiment with a given probability (p), Mr. Fisher shows that the expected value in a series of, say s, trials under a constant probability (i. e., in a Bernoullian series) is sp. Using the notation that $e(x)$ is the expected value in a series of trials of an event whose probability is $\phi(x)$ we may define the mean error of the series (x) by the equation

$$\epsilon^2(x) = \Sigma \mid x - e(x) \mid^2 \phi(x).$$

Tchebycheff's theorem then is:

"The probability that the absolute value of the difference $\mid x - e(x) \mid$ does not exceed the mean error by a certain multiplier λ ($\lambda > 1$) is greater than $1 - (1/\lambda^2)$."

If we express this probability as P_T we have

$$P_T > 1 - \frac{1}{\lambda^2}. \qquad (1)$$

I will not reproduce here the proof of this theorem which will be found in Mr. Fisher's book as already referred to.

It can be readily shown that where the probability of x is p and the number of trials n then

$$\epsilon(x) = \sqrt{npq}$$

and if the relative frequency x/n is under consideration

$$\epsilon(x:n) = \sqrt{\frac{pq}{n}} \tag{2}$$

If we now choose a constant $k < 1$ such that $\lambda\epsilon = kp$; P_T becomes the probability that $|x - e(x)| \not> kp$, that is, the departure of the indicated probability from the true probability does not exceed a given percentage of the true probability. We are concerned, of course, with the relative rather than the absolute value of x.

Substituting in $\lambda\epsilon = kp$ the value of ϵ in (2) and squaring we get

$$\frac{\lambda^2 pq}{n} = k^2 p^2,$$

from which

$$n = \frac{\lambda^2}{k^2} \cdot \frac{q}{p} \tag{3}$$

In this equation and (1) above we have set up the conditions which enable us to determine the number of trials necessary to give a probability indication of which we may say the probability exceeds a certain value that it is not more than a given percentage from the true value. It will be noted that n is fixed by three parameters, λ determined from the value taken for P_T, k the permissible percentage of error, and p the true probability. The latter is the unknown in our work, but the experience indication may generally be used as an approximation thereto.

The application of this theorem may be rapidly made to a wide range of conditions by the use of two simply constructed tables. Entering the first with P_T and k, which are the judgment constants defining the dependability of an indication, we take out λ^2/k^2. With this and the probability of the event we enter the second table and read off directly n the number of observations required.

Appendix I gives the first table for a limited range of values of P_T and k and Appendix II gives the second table for a limited range of values of λ^2/k^2 and q. It may be here noted that following the analogy of life-insurance work where p is taken as the probability of survival I have taken p to be the escape from accidental injury during the term and q the incurring of injury. As q is what we are interested in these tables are in terms of q.

A comparison of (3) with equation (7), *Proceedings*, Vol. I, p.

26, shows that they are of the same form, the simpler λ taking the place of $x = khnq$. The general conclusions noted on page 27, therefore, still stand, but since the tabular solution of the problem is so simple and the construction of the tables also so easy, it is not necessary to give much consideration to such general statements of tendencies.

The tables may also be used in a different way, which may prove of greater practical value, taking the problem from a slightly different point of view. Given a certain exposure and hazard indication we may wish to know the probability that this is within a given percentage of the true value. Entering the second table with the indicated value of q and the known value of n we may read of the value of λ^2/k^2 interpolating if the table is not sufficiently extensive. Using this and the percentage of accuracy whose probability is desired, we may read off from Table I the value of P_T the probability sought.

The second use may prove of particular value in connection with the making of premiums to cover complex benefits for widely varying hazards. Obviously the direct application of the theory can deal only with a simple hazard, but we may use the tables in the second way to judge the accuracy of the experience indication for the several kinds of benefits and make such correction as appears necessary in the total result, bearing in mind that deviation in excess in one part may be offset by deviations in deficiency for the other part while our theory deals only with absolute values of departures.

Throughout the above we have used the theory of probability without discussing its basic definitions. In general it has been assumed necessary in compensation work to express probabilities in terms of annual full-time workers, and then convert that result into terms of payroll. I do not believe this is necessary.

The fundamental definition of probability of an event is the ratio of conditions favorable to the occurrence to the totality of equally likely conditions governing the occurrence.

In general we look upon this as limited to occurrence in the physical world, e. g., the drawing of a ball from an urn, the falling of a die with a particular face up, the death of a person, etc. If the fundamental conditions of the definition are adhered to there appears to be no reason why there should be strict limitation to physical events—why it is not rational to substitute some other

measure associated with the event for the event itself. For example, there seems to be no reason for concluding that the life companies are not justified in investigating mortality experience and constructing a table therefrom on the basis of policies or amounts of insurance rather than lives. Having regard to practical business conditions there are marked advantages in so doing.

The same principle would apply to compensation insurance, taking, for example, death cases. Unless the terms of the compensation act and variation in marital conditions of injured persons make it such that sharper distinctions should be recognized, there appears to be no impropriety in taking the amount of death claims rather than the number of deaths as the numerator of the probability fraction. Again, the denominator which expresses the total possibility has usually been taken as the number of persons exposed during the year from which the deaths are presumed to arise. There is nothing sacred about the year as the unit for the probability and we might equally well express our probabilities in terms of weeks or months or some other unit, as for example, unit of payroll exposure, and we might use as our probability a probability of death or a fixed monetary loss within the term during which a given amount of payroll would be expended. It would thus seem that if we deal only with occurrences having approximately the same probability and cost we might be justified in treating the pure premiums for that element of benefit as its probability, or in erecting a probability which would compare the number of units of death loss, for example, with the corresponding number of similar units of payroll exposure. The probability might then be expressed as the probability that 100 per cent. of the payroll unit would be required for compensation for fatal accidents arising out of the expenditure of that unit.

It would seem that the fundamental requirement of the definition of equal likelihood of each condition entering into the denominator would be violated if we did not confine ourselves in this work to hazards of a like nature and of approximately like freqency of occurrence.

The advantage of this treatment, if it is logical, as I believe it is, is that it avoids the necessity of arbitrary assumption or statistical investigations as to average wages by which we may pass from a probability expressed in terms of the individual into a rate based upon wages or payroll. We only require to determine the average compensation cost per occurrence of the type under consideration.

The theories presented above will probably be made more clear by a few illustrative examples.

Let us consider the medical cost in a low-rated group where the pure premium for medical and hospital service is about 5 cents or 6 cents per $100 of payroll. Let us take the average medical bill at say $10. A pure premium of 5 cents or 6 cents per $100 means a probability of .0005 or .0006 that a unit of payroll exposure is required for medical cost. We may wish to know how large a volume of data will be required in order that we may say of the indicated value of the medical pure premium there is less than one chance in ten that there is an error in it exceeding 10 per cent. of itself. Here P_r is .9 and k is .10. Using Table I we find λ^2/k^2 is 1,000. Then from Table II we find the number of units required if q is .0005 is 1,999,000 and if q is .0006 is 1,656,667. Since the unit is $10 this means the payroll exposure required is between $16,000,000 and $20,000,000.

Of course, this standard of accuracy is very high. Were we content with a probability somewhat more than eight in 10 that the error did not exceed 10 per cent., we would find the value of λ^2/k^2 is 500, and from Table II that about half the payroll exposure indicated above would be required. For a probability of more than nine in ten that the error does not exceed 20 per cent. λ^2/k^2 equals 250, whence we require about 500,000 units or $5,000,000 of payroll exposure. And if we are content with a probability of eight in ten that the error does not exceed 20 per cent., the value of λ^2/k^2 becomes 125 and we require but 250,000 units or $2,500,000 of payroll exposure.

As another illustration we may take a death benefit which is assumed to cost on the average $3,000. With the pure premium in the same neighborhood, and with the same standards of accuracy we would have the same number of units required, but the unit would here be $3,000 or 300 times as much as in the other case, so that for a probability greater than 90 per cent. that the error doesn't exceed 10 per cent. we would require an exposure of $6,000,000,000. For the case of a probability of more than 80 per cent. that the error doesn't exceed 20 per cent. we would require an exposure of $150,000,000.

Let us take as a further example of the theory temporary disability where the pure premium is about 20 cents per $100 of payroll and the average cost is say $50. Here the probability of total

loss of a unit of exposure is .20/100 or .002, and the unit is $50. Let us take as our standard that the probability shall exceed three in four (75 per cent.) that the error in the indicated pure premium does not exceed 15 per cent. Here P_T is .75 and k is .15 from which by Table I $\lambda^2/k^2 = 177$ and using this and $q = .002$ we get by Table II that n is about 8,500 units. Since the unit is $50 this means we must have $425,000 of payroll exposure to give us a pure premium indication of the desired dependability.

We may illustrate the second application of these theories by using the following data from the returns of all companies on Massachusetts Schedule Z, 1916, Part II, courteously furnished by Mr. E. S. Cogswell of the Massachusetts Insurance Department.

Classification.	Actual 2,660.	Pure Prem. per $100.	2,222.	Pure Prem. per $100.	2 286.	Pure Prem. per $100.
Total pay roll....	$78,943,253		$65,343,542		$39,593,977	
Total incurred losses for death.	12,861	.0163	26,412	.0404	7,091	.0179
Specific indemnity	14,596	.0185	13,721	.0210	9,642	.0244
Perm. total.....	3,538	.0045	10,048	.0154	4,000	.0101
Perm. partial....	7,646	.0097	8,874	.0136	6,526	.0165
Temporary.....	67,924	.0860	166,543	.2549	60,829	.1536
Medical hospital .	45,961	.0582	53,878	.0825	32,094	.0811

Taking the permanent partial element of classification 2,660, for example, we may fairly assume $1,000 as the average cost per case. We then have 7.6 occurrences out of 78,943 exposures giving a probability of .000097 or approximately .0001. We have to ex-

TABLE I.

VALUES OF "λ^2/k^2."

	k equals				
P_T.	.05.	.10.	.15.	.20.	.25.
.95.....	8,000	2,000	888	500	320
.90.....	4,000	1,000	444	250	160
.85.....	2,666	666	296	166	107
.80.....	2,000	500	222	125	80
.75.....	1,600	400	177	100	64
.70.....	1,333	333	148	83	53
.65.....	1,143	286	127	71	46
.60.....	1,000	250	111	62.5	40
.55.....	888	222	98.8	55.6	35

trapolate on line 10 of Table II to get the value of λ^2/k^2 which we can see will be very small, viz., about 8. Again this value of λ^2/k^2 is not found in Table I but by using the formula we can see that the probability does not greatly exceed $\frac{1}{2}$ that the indication is within 50 per cent. of the true indication. This seems to be in accord with what might be our subjective judgment on the problem.

If we assume the average temporary case to cost about $25 for temporary disability compensation, we have 2,717 occurrences in classification 2,660 out of 3,157,730 exposures. Our q is .0009 nearly. Table II shows that λ^2/k^2 is slightly more than 3,000. (This value is not shown in the table but is easily seen by noting the value of p/q and dividing 3,157,730 by it.) Table I showed a

TABLE II.

VALUES OF "n."

		λ^2/k^2 equals				
q.	p/q.	λ^2/k^2 1,000.	900.	800.	700.	600.
.00001	99,999	99,999,000	89,999,100	79,999,200	69,999,300	59,999,400
.00002	49,999	49,999,000	44,999,100	39,999,200	34,999,300	29,999,400
.00003	33,332	33,332,333	29,999,100	26,665,866	23,332,633	19,999,400
.00004	24,999	24,999,000	22,499,100	19,999,200	17,499,300	14,999,400
.00005	19,999	19,999,000	17,999,100	15,999,200	13,999,300	11,999,400
.00006	16,665.66	16,665,667	14,999,100	13,332,533	11,665,967	9,999,400
.00007	14,285	14,284,714	12,856,243	11,427,771	9,999,300	8,570,828
.00008	12,499	12,499,000	11,249,100	9,999,200	8,749,300	7,499,400
.00009	11,110.1	11,110,111	9,999,100	8,888,089	7,777,078	6,666,067
.0001	9,999	9,999,000	8,999,100	7,999,200	6,999,300	5,999,400
.0005	1,999	1,999,000	1,799,100	1,599,200	1,399,300	1,199,400
.0010	999	999,000	899,100	799,200	699,300	599,400
.0015	665.6	665,667	599,100	532,534	465,967	399,400
.0020	499	499,000	449,100	399,200	349,300	299,400
.0025	399	399,000	359,100	319,200	279,300	239,400
.003	332.3	332,333	299,100	265,867	232,633	199,400
.004	249	249,000	224,100	199,200	174,300	149,400
.005	199	199,000	179,100	159,200	139,300	119,400
.006	165.6	165,667	149,100	132,533	115,967	99,400
.007	141.857	141,860–	127,671	113,486	99,300	85,114
.008	124	124,000	111,600	99,200	86,800	74,400
.009	110.11	110,111	99,100	88,089	77,078	66,067
.01	99	99,000	89,100	79,200	69,300	59,400
.02	49	49,000	44,100	39,200	34,300	29,400
.03	32.3	32,333	29,100	25,867	22,633	19,400
.04	24	24,000	21,600	19,200	16,800	14,400
.05	19	19,000	17,100	15,200	13,300	11,400
.06	15.6	15,667	14,100	12,533	10,967	9,400
.07	13.28	13,280	11,957	10,629	9,300	7,971
.08	11.5	11,500	10,350	9,200	8,050	6,900
.09	10.1	10,111	9,100	8,087	7,078	6,067
.10	9.0	9,000	8,100	7,200	6,300	5,400

q.	p/q.	λ^2/k^2 500.	400.	300.	200.	100.
.00001	99,999	49,999,500	39,999,600	29,999,700	19,999,800	9,999,900
.00002	49,999	24,999,500	19,999,600	14,999,700	9,999,800	4,999,900
.00003	33,332	16,666,167	13,332,933	9,999,700	6,666,467	3,333,233
.00004	24,999	12,499,500	9,999,600	7,499,700	4,999,800	2,499,900
.00005	19,999	9,999,500	7,999,600	5,999,700	3,999,800	1,999,900
.00006	16.665.66	8,332,833	6,666,267	4,999,700	3,333,133	1,666,567
.00007	14,285	7,142,357	5,713,886	4,285,414	2,856,943	1,428,471
.00008	12,499	6,249,500	4,999,600	3,749,700	2,499,800	1,249,900
.00009	11,110.1	5,555,056	4,444,044	3,333,033	2,222,022	1,111,011
.0001	9,999	4,999,500	3,999,600	2,999,700	1,999,800	999,900
.0005	1,999	999,500	799,600	599,700	399,800	199,900
.001	999	499,500	399,600	299,700	199,800	99,900
.0015	665.6	332,833	266,267	199,700	133,133	66,567
.002	499	249,500	199,600	149,700	99,800	49,900
.0025	399	199,500	159,600	119,700	79,800	39,900
.003	332.3	166,167	132,933	99,700	66,467	33,233
.004	249	124,500	99,600	74,700	49,800	24,900
.005	199	99,500	79,600	59,700	39,800	19,900
.006	165.6	82,833	66,267	49,700	33,133	16,567
.007	141.857	70,929	56,743	42,557	28,371	14,186
.008	124	62,000	49,600	37,200	24,800	12,400
.009	110.1	55,056	44,044	33,033	22,022	11,011
.01	99	49,500	39,600	29,700	19,800	9,900
.02	49	24,500	19,600	14,700	9,800	4,900
.03	32.3	16,167	12,933	9,700	6,467	3,233
.04	24	12,000	9,600	7,200	4,800	2,400
.05	19	9,500	7,600	5,700	3,800	1,900
.06	15.6	7,833	6,267	4,700	3,133	1,567
.07	13.286	6,643	5,314	3,986	2,657	1,329
.08	11.5	5,750	4,600	3,450	2,300	1,150
.09	10.1	5,056	4,044	3,033	2,022	1,011
.10	9	4,500	3,600	2,700	1,800	900

very high probability that the indication is not in error 5 per cent. on account of the influence of chance.

The medical will be found to have about as high accuracy.

Taking the specific indemnity element and remembering the Massachusetts provision we may perhaps take $200 as a fair round figure per case. This gives us approximately 400,000 exposures with 73 occurrences. $q = .0002$ nearly. Table II shows λ^2/k^2 is approximately 100. And from Table I we may say the probability exceeds 75 per cent. there is not a 20 per cent. error in the result, that it exceeds 85 per cent. there is not a 25 per cent. error, but it only exceeds about 57 per cent. that there is not an error of 15 per cent.

Other examples may be worked out at will. I believe a careful use of this criterion will be of great value in analyzing data to be used in rate-making. A little practice with the Tables will develop great rapidity in their use. The construction of the Tables is very

simple and they may, therefore, easily be extended to cover a wider range or proceed by narrower graduations.

Although the above theorem has been presented primarily with a view to its application to workmen's compensation rate-making, there seems to be no reason why it may not be equally applicable to similar problems in personal accident insurance, fire insurance and elsewhere, and indeed, I am not sure that it may not be possible to develop in this way methods by which the data at different ages might be appropriately weighted preliminary to the graduation of a mortality table.

THE THEORY OF EXPERIENCE RATING.

BY

ALBERT W. WHITNEY.

This paper traces in an informal way the general line of reasoning that was pursued in an investigation into the theory of experience rating which was made recently by the Actuarial Section of the National Reference Committee on Workmen's Compensation Insurance. This investigation resulted in the adoption by the Section of a general plan which was approved by the National Reference Committee and is now before the various Bureaus for such action as each may see fit to take.

The problem of experience rating is peculiar to workmen's compensation insurance and a few other types of insurance. The problem is not found in life insurance, except potentially in group insurance, and not at all in fire insurance so far as I know.

The problem exists only in those forms of insurance in which there is a risk-experience as distinguished from a class-experience. In the case of life insurance death occurs but once and in the case of fire insurance likewise the occurrence of a fire is so rare that the experience of the risk is of little evidential value in itself. In these cases therefore it is perforce necessary to associate the risk with other similar risks to form a class and the hazard of the risk must be identified with the hazard of the class.

In workmen's compensation insurance, some kinds of liability insurance, group insurance and possibly a few other types of insurance, the risk insured, and upon which a rate must be produced, affords an experience of its own, that is, the contingencies insured against are of sufficiently frequent occurrence so that the risk itself produces an experience having some evidential value. In such cases we have therefore both a class-experience and a risk-experience.

The problem of experience rating arises out of the necessity, from the standpoint of equity to the individual risk, of striking a balance between class-experience on the one hand and risk-experience on the other.

Here is a risk, for instance, that is clearly to be classified as a machine shop. In the absence of other information it should therefore take the machine shop rate, namely, the average rate for all risks of this class. On the other hand the risk has had an experience of its own. If the risk is large, this may be a better guide to its hazard than the class-experience.

In any event, whether the risk is large or small, both of these elements have their value as evidence, and both must be taken into account. The difficulty arises from the fact that in general the evidence is contradictory; the problem therefore is to find and apply a criterion which will give each its proper weight.

Before proceeding to make a mathematical analysis of the situation, in fact before attempting to set up a criterion for striking a balance, an enumeration may be made of the elements which will figure in the result, with an intuitive estimate of their general effect.

It is evident in the first place that the weight of the risk-experience will depend upon the risk-exposure. Other things being equal, the experience of that risk which has the larger exposure will be entitled to the larger degree of consideration. In the case of a very large risk the rate may with safety be based almost wholly upon its own experience; in the case of a small risk very little credence can be given to risk-experience and the rate must be based almost wholly upon the experience of the class.

Essentially the same relationship holds true in the case of the hazard; the larger the hazard, the larger will be the number of accidents, the exposure remaining the same, and therefore the more trustworthy the average. If, however, the varying credibility of the class-experience is taken into account, since a large hazard will affect this in approximately the same way that it affects the risk-experience, it will be difficult to say what the net effect on the balance will be.

There would be no experience-rating problem if every risk within the class were typical of the class, for in that case the diversity in the experience would be purely adventitious. The problem arises out of the necessity of assessing the degree to which the disparity between risk-experience and class-experience reflects a real divergence between the true risk-hazard and the average hazard of the class rather than mere chance. It is therefore neces-

sary in discussing this problem to have some measure of the degree of dispersion of risks within the class, that is, the degree to which the true hazard of the various risks differs from the average hazard of the class.

Now this is strictly a matter for statistical treatment. Doubtless the risks in each classification do group themselves as to their true hazard about the average hazard of the class in some particular way that is expressible by means of some particular frequency curve. While it would be interesting in a certain number of cases to make an investigation into the actual facts, it is evident that as a practical matter for rating purposes, such a procedure for each classification would be utterly out of the question. We are therefore forced to make some assumption with regard to the law of frequency of risks of various degrees of hazard.

From a general knowledge of conditions we are safe in assuming that this law as a first approximation may be taken to be of the normal type. There will doubtless be some skewness, but since the investigation that we are to conduct is primarily for the purpose of ascertaining the proper rating structure rather than quantitative values, this assumption is under the circumstances justifiable. The standard deviation may be taken as the measure of dispersion.

Now it is evident intuitively that if the risks are concentrated within the class, that is, if the standard deviation is small, a risk-experience that departs from the average of the class can be more easily accounted for as due to chance than as due to an inherent difference in the degree of hazard. On the other hand, if the standard deviation is large, that is if the risks are diverse, it is inherently likely that a risk-experience that departs from the average is to be accounted for by a real difference in the hazard.

Another element that in theory may be taken account of is the varying credibility of the manual rate. The manual rate is established upon experience which in a majority of classifications is insufficient and which in many cases has been supplemented by judgment. It is evident that, other things being equal, the higher the credibility of the manual rate, the greater its weight in establishing the balance between class-experience and risk-experience. If, on the other hand, the manual rate is established upon insufficient experience, we shall be inclined to give greater relative credence to the risk-experience.

To summarize: the balance between class-experience and risk-experience will depend upon four elements, the exposure, the hazard, the degree of concentration within the class and the credibility of the manual rate. The larger the risk-exposure, the greater the credibility of the risk-experience, while the greater the concentration of risks within the class and the greater the credibility of the manual rate, the greater the credibility of the class-experience; an increased hazard makes both class-experience and risk-experience more trustworthy so that the net effect is not intuitively obvious.

The detailed solution of this problem depends upon the use of inverse probabilities and as the expressions involved are somewhat complicated, it will be convenient to use for this purpose symbols and an analysis adapted from the algebra of logic.

A, in a symbolic sense, may be taken to mean the happening of the event A; $A+B$ means the happening of A or B, logical addition being interpreted as "or"; AB means the happening of both A and B, logical multiplication being interpreted as "and"; AB/A means the happening of B (and therefore A) if A happens, logical division being interpreted as "if." $\bar{A}$ means not A.

$A \cdot (AB/A) = AB$, or the happening of A and the happening of B if A happens is equivalent to the happening of both A and B.

The probability of the happening of A may be denoted by $|A|$. $|A+B| = |A| + |B|$, provided A and B are completely disjunctive; in any case $|A+B| = |A| + |\bar{A}B|$ or $|A\bar{B}| + |B|$. In the expressions on the right the operation of addition is quantitative not logical, and in general the operations within the sign $|\ |$ are logical while the operations without are quantitative. There is a relationship between the logical and quantitative operations such that in taking the probability of a logical expression, under certain restrictions, logical relations pass over into the corresponding quantitative relations.

$|A \cdot (AB/A)| = |A|\,|(AB/A)|$, from which it follows that $|AB/A| = |AB| / |A|$. $|AB|$ is however in general not equal to $|A|\,|B|$.

Suppose the following:

P is the hazard of the class as shown by the class-experience, that is, P is the indicated hazard of the class, (known); X is the real hazard of the class, (unknown); p is the indicated hazard of the risk, (known); x is the real hazard of the risk, (unknown). As

a logical symbol P will be used to mean the occurrence of an indicated class hazard equal to P^* and similarly for X, p and x.

The first problem is to find $|Ppx/Pp|$, that is $|Ppx|/|Pp|$, that is, to find the probability that x is the real hazard of the risk if P is the indicated hazard of the class and p the indicated hazard of the risk.

Now $Ppx = \Sigma_X XPpx$, the sign of summation here indicating that the expression $XPpx$ is to be summed for all X's.

Therefore

$$Ppx = \sum_X X \cdot \frac{XP}{X} \cdot \frac{XPx}{XP} \cdot \frac{XPxp}{XPx}$$

and

$$|Ppx| = \sum_X |X| \left|\frac{XP}{X}\right| \left|\frac{XPx}{XP}\right| \left|\frac{XPxp}{XPx}\right|. \qquad (1)$$

These factors may be discussed seriatim:

$|X|$ is an a priori value, that is, none of the known facts, either explicit or implied, are admitted as evidence; from this point of view one value of the real hazard of the class will be as probable as another. $|X|$ may therefore be taken to be a constant c independent of the quantities P and p.

$|XP/X|$ is the probability that P will be the class-hazard indicated by experience if X is the real class-hazard. For our purposes we may suppose the contingency to be a simple one such as death. Suppose there are m persons exposed to such a hazard whose value is X. Then $|XP/X|$ may be described as the probability that, of these m persons, mP will experience the contingency in question. This probability is the $(mP+1)$th term in the expansion $[(1-X)+X]^m$ or

$${}_mC_{mP}(1-X)^{mQ}X^{mP}, \quad \text{where} \quad P+Q=1.$$

* There is the possibility here of confusion, since each of these symbols is used in three senses, for instance, P is first used quantitatively, namely as the indicated value of the class-hazard, second in a logical sense as the occurrence of P as the indicated value of the class-hazard and third quantitatively in the form $|P|$ as the probability of the occurrence of P as the indicated value of the class-hazard. The context should, however, make clear which is meant.

This can be represented approximately by

$$\frac{H'}{\sqrt{\pi}} e^{-H'^2(P-X)^2} \quad \text{where} \quad H'^2 = \frac{m^*}{2X(1-X)}.$$

$|\, XPx/XP \,|$ is in reality independent of P and is therefore the same as $|\, Xx/X \,|$. This, the probability of occurrence of a risk with real hazard x within the class whose real hazard is X, is dependent upon the law of frequency of distribution of risks within the class. If we assume that this law of frequency is normal with a modulus H then

$$\left| \frac{Xx}{X} \right| = \frac{H}{\sqrt{\pi}} e^{-H^2(x-X)^2}.$$

$|\, XPxp/XPx \,|$ is independent of both X and P, that is, it is the same as $|\, xp/x \,|$, that is, it is the same as the probability of occurrence of an indicated risk-hazard p if the real risk-hazard is x. If we suppose the number of persons exposed to the hazard whose value is x is n, the value of $|\, xp/x \,|$ will be the $(np+1)$th term in the expansion $[(1-x)+x]^n$ or ${}_nC_{pn}(1-x)^{qn}x^{pn}$ where $p+q=1$. This can be written approximately $(h/\sqrt{\pi})e^{-h^2(p-x)^2}$ if we choose, where $h^2 = n/[2x(1-x)]$. Collecting these factors together we have

$$|\, Ppx \,| = \sum_X c \frac{H'}{\sqrt{\pi}} e^{-H'^2(P-X)^2} \cdot \frac{H}{\sqrt{\pi}} e^{-H^2(x-X)^2} \cdot {}_nC_{pn}(1-x)^{qn}x^{pn}. \quad (2)$$

We now have to consider the quantity

$$\sum_X \frac{HH'}{\pi} e^{-[H'^2(P-X)^2 + H^2(x-X)^2]}. \quad (3)$$

This can be written

$$\sum_X \frac{HH'}{\pi} e^{-(H'^2+H^2)\left[X - \frac{PH'^2+xH^2}{H'^2+H^2}\right]^2} e^{-\frac{H'^2H^2}{H'^2+H^2}(x-P)^2}. \quad (4)$$

H'^2 in reality is equal to $m/[2X(1-X)]$; it can however without serious error, since the significant values of X are in the vicinity of P, be written $m/[2P(1-P)]$. If this is done the expression above can be written

* This differs from the more familiar expression because of the fact that X and P represent *ratios* of occurrence instead of *number* of occurrences.

$$\frac{\sqrt{\frac{H^2H'^2}{H'^2+H^2}}}{\sqrt{\pi}} e^{-\frac{H^2H'^2}{H^2+H'^2}(x-P)^2} \times \sum_X \frac{\sqrt{H'^2+H^2}}{\sqrt{\pi}} e^{-(H^2+H'^2)\left[X-\frac{PH'^2+xH^2}{H^2+H'^2}\right]^2}. \quad (5)$$

Since X is to be taken as a continuous variable, the sum in expression (5) becomes an integral, namely,

$$\int_{-\infty}^{+\infty} \frac{\sqrt{H'^2+H^2}}{\sqrt{\pi}} e^{-(H^2+H'^2)\left[X-\frac{PH'^2+xH^2}{H^2+H'^2}\right]^2} dX \quad (6)$$

and the value of this is 1.

The value of $|\, Ppx \,|$ is therefore

$$\frac{\sqrt{\frac{H^2H'^2}{H^2+H'^2}}}{\sqrt{\pi}} e^{-\frac{H^2H'^2}{H^2+H'^2}(x-P)^2} {}_nC_{pn}(1-x)^{qn}x^{pn}. \quad (7)$$

The denominator of $|\, Ppx/Pp \,|$, viz., $|\, Pp \,|$, is the same as the numerator except that it is to be summed for all values of x. It will therefore be a function of P, p, n, m, and H^2, namely a constant independent of x.

Finally therefore the value of $|\, Ppx/Pp \,|$ will be

$$Ce^{-\frac{H^2H'^2}{H^2+H'^2}(x-P)^2}(1-x)^{qn}x^{pn} \quad (8)$$

all the constants being combined into one.

In the first working out of this problem the assumption was made that the indicated class-hazard could be taken as the real class-hazard, and in the practical application of an experience rating plan this is doubtless the only feasible procedure. The process and results under this hypothesis are simpler. P can then be taken as X and no integration with regard to X is necessary.

$|\, Ppx/Pp \,|$ in that case is

$$C'e^{-H^2(x-P)^2}(1-x)^{qn}x^{pn}, \quad (9)$$

that is $H^2H'^2/(H^2+H'^2)$ reduces to H^2. This is evident directly: X and P will approach equality as the experience increases; but as m approaches ∞, H'^2 approaches ∞, and $H^2H'^2/(H^2+H'^2)$ approaches H^2 as a limit.

Mr. W. W. Greene, chairman of the Actuarial Section, proposed as an alternative treatment the assumption that all the risks in the class are homogeneous, that is, $H^2 = \infty$, and that the balance between class-experience and risk-experience be made solely on the basis of the relative credibility of class-experience and risk-experience. Under this assumption X would be the same as x, that is, the hazard of the class and the hazard of the risk would be equal. This assumption would yield the result:

$$\left|\frac{Ppx}{Pp}\right| = C'' e^{-H'^2(P-x)^2}(1-x)^{qn}x^{pn}, \qquad (10)$$

that is, $H^2H'^2/(H^2+H'^2)$ would reduce to H'^2. This also follows directly by letting H^2 approach ∞. All three of these results are evidently of the same general form.

Let us now revert to the more general formula (8). This expresses the probability that x is the real value of the risk-hazard; this is a function of the known quantities P, p, m, n and H^2.

What criterion shall now be made use of in selecting the value of x to be used, the object namely of our investigation? The value of x that we instinctively choose is that one whose probability of occurrence is greatest, and this upon analysis means that value of x which would have made the thing which has actually occurred the most a priori probable. As Mr. A. H. Mowbray has pointed out, however, this involves a subtle repudiation of the fundamental thesis of insurance, viz., a dependence upon the law of averages.

The fundamental theory of insurance involves this, that, at the point when the effort to analyze and differentiate the hazard of various risks has been carried as far as is deemed feasible, the risks in each residuum shall be treated as of equal hazard. This means therefore that each risk shall take the average hazard of the group.

Suppose we had a large number of cases in which we knew the indicated class-hazard to be P and the indicated risk-hazard to be p. The real risk-hazard would doubtless vary from case to case, yet we should have nothing by which to distinguish one case from another and so we should be obliged to take for each the average hazard of the group. This can be done in our theoretical treatment by affecting each value of x with its corresponding frequency factor $|Ppx/Pp|$ and averaging the result; that is we should properly take the mean value of x and not the most probable value of x.

As a practical matter, however, it is expedient to use the most probable value rather than the mean. If instead of ${}_nC_{pn}(1-x)^{qn}x^{pn}$ we use the approximate function $(h/\sqrt{\pi})e^{-h^2(p-x)^2}$ and for h^2 take $n/[2P(1-P)]$; which however will be only approximately correct, we shall have for $|Ppx/Pp|$ a strictly normal and therefore symmetrical function in which the mean and the mode will agree.

In any case the discrepancy between the mean and the mode will probably be small, and not worth considering for the prime purpose of this investigation, namely, the discovery of a structure for an experience rating plan. The determination of mean values would be attended by mathematical difficulties whereas the determination of the mode is comparatively simple.

Our problem therefore is to find that value of x which will make

$$Ce^{-\frac{H^2H'^2}{H^2+H'^2}(x-P)^2}(1-x)^{qn}x^{pn}$$

a maximum. Taking the logarithm, differentiating and equating to zero, and for convenience abbreviating

$$\frac{H^2H'^2}{H^2+H'^2} \quad \text{by } J^2,$$

we have the condition for a maximum:

$$-2J^2(x-P)-\frac{qn}{1-x}+\frac{pn}{x}=0 \tag{11}$$

which reduces to the cubic:

$$x^3-(1+P)x^2+\left(P-\frac{n}{2J^2}\right)x+\frac{n}{2J^2}p=0,$$

or by letting $n/2J^2=A$:

$$x^3-(1+P)x^2+(P-A)x+Ap=0. \tag{12}$$

A further insight into the existence of a maximum may be had by considering the parts of (11) separately, viz., $-2J^2(x-P)$ and $n(p-x)/x(1-x)$.

When $p>P$, the first is 0 for $x=P$ and negative for $x=p$; the second is positive for $x=P$ and 0 for $x=p$. An analogous condition holds when $p<P$. Somewhere between P and p the sum of these two expressions will therefore be zero. Furthermore

it is evident from these considerations that

$$-2J^2(x-P)+\frac{n(p-x)}{x(1-x)}$$

is a decreasing function between P and p and that the solution of the cubic therefore determines a maximum. x is the adjusted value of the hazard; for our purposes, however, a more fundamental quantity will be $(x-P)/(p-P)$, namely the percentage of the deviation of the indicated risk-hazard from the indicated class-hazard which is allowed upon adjustment; let this be called z and let $p-P$ be called λ. Then $x-P=\lambda z$. Making these substitutions in (12), when thrown into the form $(x-P)(x^2-x-A)+A(p-P)=0$, we have

$$(\lambda z)^3+(2P-1)(\lambda z)^2-(A+P(1-P))\lambda z+A\lambda=0. \quad (13)$$

It is impracticable and unnecessary to consider the exact solution of this cubic; the practical problem is to find a satisfactory approximate solution.

The expression on the left of (13) which we may call y may be written

$$y=(x-P)^3+(2P-1)(x-P)^2 - (A+P(1-P))(x-P)+A(p-P). \quad (14)$$

This is a cubic curve; its point of intersection with the x axis between P and p is the point in which we are interested. By dropping the first term on the right we obtain

$$y=(2P-1)(x-P)^2 - (A+P(1-P))(x-P)+A(p-P). \quad (15)$$

This is the equation of a parabola osculating the cubic at the point whose x is P and therefore giving good approximate results for values of x that are in the vicinity of the indicated class-hazard. If we drop the first two terms we have

$$y=-(A+P(1-P))(x-P)+A(p-P). \quad (16)$$

This is the equation of the tangent to both the cubic and the parabola at the point whose x is P. This may be used for obtaining a first approximation to the solution of the cubic while the

quadratic form may be used if a closer approximation becomes necessary.

As a matter of reference we may set down explicitly the values of z got by setting equations (15) and (16) equal to zero and solving.

From equation (15) we have:

$$z = \frac{A + P(1-P) - \sqrt{(A+P(1-P))^2 - 4A\lambda(2P-1)}}{2\lambda(2P-1)}, \quad (15A)$$

which we may call the second approximation.

From equation (16) we have:

$$z = \frac{A}{A + P(1-P)}, \quad (16A)$$

which we may call the first approximation.

When $p=P$, by equation (12) $x=P$; $\therefore$ z is indeterminate. z has the limiting value however from equation (13) of $A/[A+P \times(1-P)]$. This is the same value that is given by the linear equation $-(A+P(1-P))\lambda z + A\lambda = 0$ for all values of p. That is, the first approximation to the value of z is independent of p and is the same as the value given by the cubic equation in the limiting case in which the indicated risk-hazard is the same as the indicated class-hazard.

The same result can be arrived at in another way. If instead of ${}_nC_{pn}(1-x)^{qn}x^{pn}$ we use the approximate value $(h/\sqrt{\pi})e^{-h^2(p-x)^2}$ where we take $h^2 = n/[2P(1-P)]$, equation (8) takes the form:

$$\left|\frac{Ppx}{Pp}\right| = Ce^{-[J^2(P-x)^2 + h^2(p-x)^2]}. \quad (17)$$

Differentiating, equating to zero and solving gives

$$x = \frac{J^2P + h^2p}{J^2 + h^2}, \quad (18)$$

or in terms of z,

$$z = \frac{h^2}{J^2 + h^2}. \quad (19)$$

By letting $h^2 = n/[2P(1-P)]$, and $A = n/2J^2$ we have $z = A/[A + P(1-P)]$, as before.

That is, using an approximate value for ${}_nC_{pn}(1-x)^{qn}x^{pn}$ and letting $h^2 = n/[2P(1-P)]$ instead of $n/[2x(1-x)]$ gives the

same result as using the first approximation by the more rigorous method.

Incidentally a further curious result may be observed. If in (18) we substitute for h^2 its more accurate value $n/[2x(1-x)]$, equation (18) reduces to our original cubic in x. That is, the effect of considering h^2 a constant in (17) when differentiating for a maximum is apparently just balanced by the error in using for ${}_nC_{pn}(1-x)^{qn}x^{pn}$ the less exact value $(h/\sqrt{\pi})e^{-h^2(x-p)^2}$. These equations have other curious mathematical properties which however it is not necessary, for the purpose in hand, to develop.

Equation (18) has an interesting dynamical interpretation. If the points p and P are weighted in the proportion of J^2 to h^2, then x, on the straight line joining P and p, is the center of gravity. We undertook in a figurative way to balance the risk-experience against class-experience; we now see in a literal way just what that balance is. It will be interesting to check it up against our intuitive estimate.

If in $z=h^2/(h^2+J^2)$ we replace J^2 with $H^2H'^2/(H^2+H'^2)$, and put $H'^2=m/[2P(1-P)]$, and $h^2=n/[2P(1-P)]$, we have

$$z=\frac{1}{1+\frac{1}{n}\left[\frac{1}{\frac{1}{m}+\frac{1}{2H^2P(1-P)}}\right]}. \qquad (20)$$

From this it is evident that z increases with an increase in n, and that it decreases with an increase in m and with an increase in H^2. This agrees with our intuitive estimate. The situation as regards P is, as we surmised, complicated, particularly by the fact that H^2 itself is a function of P. Under the assumption that has been adopted by the Actuarial Section regarding the relation between H^2 and P, which will be explained later, an increase in P will produce an increase in z.

We may now turn our attention to the question of a practical method of producing a system of z's.

We have seen that if instead of ${}_nC_{pn}(1-x)^{qn}x^{pn}$ we use $(h/\sqrt{\pi})e^{-h^2(x-p)^2}$, where $h^2=n/2P(1-P)$, we obtain the relation: $z=h^2/(h^2+J^2)$ or $z=A/[A+P(1-P)]$, the same re-

sult given by the first approximation. This may be investigated in another way, namely, by throwing (17) into the form:

$$\left|\frac{Ppx}{Pp}\right| = C_1\sqrt{\frac{J^2+h^2}{\pi}}e^{(J^2+h^2)^*\left(x-\frac{J^2P+h^2p}{J^2+h^2}\right)^2}. \qquad (21)$$

This is evidently a normal curve with its mode (and mean) at $x=(J^2P+h^2p)/(J^2+h^2)$. In the case, therefore, of a normal curve, in which the mode and the mean agree, the value of z will be independent of p. The fact that the second approximation, and the cubic itself, gives a value of z that is a function of p is evidently a consequence of the skewness of the frequency curve for x when ${}_nC_{pn}(1-x)^{qn}x^{pn}$ is used instead of $(h/\sqrt{\pi})e^{-h^2(x-p)^2}$.

When z is independent of p the question of the balance of the adjusted rates is not involved, as Mr. J. H. Woodward has pointed out. This may be explained in the following way: the risks belonging to a class with a given P, H and m, having a given n, may be thought of as constituting an array. But the distribution of risks in this array as to their indicated hazard will in theory be symmetrical with regard to P. Any basis for an adjustment of rates which is independent of p (or which is an even function of $p-P$) will leave the symmetry of the distribution about P undisturbed.

The second approximation, and the cubic itself, produces values of z that are greater for $p<P$ than for $p>P$, that is, it gives greater credits than debits. There are evidently curious questions involved here, depending partly upon the fact of skewness and partly upon the fact that the mode was used instead of the mean. As a practical matter it seems unnecessary to pursue these questions further because of the satisfactory character of the results produced by the first approximation, its very much greater simplicity and the fact that its use does not affect the balance.

We may therefore turn to the question of a practical treatment of the formula $z=h^2/(h^2+J^2)$ or $z=A/[A+P(1-P)]$, where $h^2=n/[2P(1-P)]$, $J^2=(H^2H'^2)/(H^2+H'^2)$, $H'^2=m/[2P(1-P)]$ and $A=n/2J^2$. $z=h^2/(h^2+J^2)$ may be written

* Incidentally attention may be called to the fact that this equation also indicates the probable error of x, namely $.67\frac{1}{\sqrt{2(J^2+h^2)}}$

$$z = \frac{n}{n + \dfrac{m}{1 + \dfrac{m}{2H^2P(1-P)}}} \quad \text{or} \quad z = \frac{Pn}{Pn + \dfrac{Pm}{1 + \dfrac{Pm}{2H^2P^2(1-P)}}}. \tag{22}$$

Pn is the expected number of persons to suffer the contingency in question as shown by the risk-experience. Pm is the same for the class-experience; for a given classification Pm may be taken as a constant. Consider now the quantity $2H^2P^2(1-P)$. $2H^2 = 1/\epsilon^2$ where ϵ is the standard deviation; making the substitution we have $2H^2P^2(1-P) = P^2(1-P)/\epsilon^2$. We now come to the most difficult question of all, the determination of ϵ^2. It is obviously impossible as a practical matter to determine ϵ^2 statistically in each case. Some general assumption must therefore be made regarding its form and numerical value. In this we must be guided partly by general reasoning and partly by testing the results produced under various assumptions by an appeal to underwriting judgment. It is obvious in the first place that ϵ varies in some way with P; when the average hazard of the class is large, the variation in hazard among the risks of the class will be large, other things being equal. This is not to say that this is so in all cases but as a general proposition the statement is unquestionable. Trials were made with various laws for ϵ^2. The best results over the whole range of values of P were produced by allowing ϵ^2 to vary directly as $P^{\frac{1}{2}}$, and extensive tables were figured out on this basis. The formula is however complicated and not adapted to use without tables.

Mr. Greene made the suggestion that in equation (22) the second term of the denominator be taken as a constant. We have already remarked that Pm is constant for a given classification; there is no reason however to suppose that as the hazard increases the exposure decreases as would be the case if Pm were constant for all values of P.

This brings us to the question of whether it is desirable in actual practice to admit the varying credibility of the class-experience and hence of the manual rate. We know that the manual rates for some classifications are more reliable than for others and yet it is doubtful whether it is expedient in practice to recognize this fact except as regards the greater alterability of rates that are not fully substantiated by experience.

Mr. Greene's suggestion implies in effect that in the case of all

classes we should act as though we had the same statistical resources as regards the number of accidents that have actually occurred. Another treatment which in the end would lead to a similar result upon the formula would be to assume that in all classes the statistics were ample, that is in effect, that m was infinite. Equation (22) would then reduce to

$$z = \frac{Pn}{Pn + \frac{P^2(1-P)}{\epsilon^2}}. \tag{23}$$

In either case Mr. Greene's suggestion that the second term of the denominator be taken to be a constant would imply that ϵ^2 should vary as $P^2(1-P)$. Since $1-P$ is very nearly 1, this means that ϵ varies nearly as P. As a matter of fact this does not produce satisfactory values of ϵ over the whole range of values of P. In the actual use of the experience rating plan however, the contingencies are separated on each risk into two groups and the two groups are treated independently as will be explained later, so that this offers the opportunity to select different values of K' for the two groups in the equation $K'\epsilon^2 = P^2(1-P)$. When this is done the results are very satisfactory.

The simplicity of the formula

$$z = \frac{Pn}{Pn + K} \tag{24}$$

is remarkable; not only are the operations easily performed, but another advantage arises from the fact that P and n are always associated in the form Pn, which in application involves merely earned premiums; if, for instance, it were desirable to tabulate the values of z, they could be put in the form of a one-way table instead of a two-way table which would be required if z were a function of P and n separately. The mooted question is also answered with regard to the effect of the hazard upon the balance between risk-experience and class-experience; it is apparent that the hazard plays exactly the same rôle as the exposure.

The practice of experience-rating involves the joint use of the two equations:

$$x = P + z(p-P), \tag{25}$$

and

$$z = \frac{Pn}{Pn + K}. \tag{24}$$

The application of the theory will be treated in a paper by Mr. Michelbacher. It is obvious, however, in a general way that the practical questions to be answered involve first the determination of K and second the preparation, from the experience, of the quantities Pn and p, the determination of p being the main practical problem. A few general observations with regard to these matters may be made, without exceeding the proper confines of this paper.

In the preceding discussion P, p and x are hazards, that is probabilities. These quantities are connected with the corresponding rates $[P]$, $[p]$ and $[x]$ by a relation of the general form:

$$\text{Rate} = \frac{\left(\begin{matrix}\text{Number of workers}\\ \text{exposed}\end{matrix}\right)\left(\begin{matrix}\text{probability of}\\ \text{accident}\end{matrix}\right)\left(\begin{matrix}\text{average loss}\\ \text{per accident}\end{matrix}\right)}{\left(\begin{matrix}\text{number of workers}\\ \text{exposed}\end{matrix}\right)\left(\begin{matrix}\text{average annual payroll}\\ \text{per worker}\end{matrix}\right)}$$

The quantity expressing the number of workers exposed cancels out of both numerator and denominator; the average loss per accident and the average annual payroll per worker are assumed constant for a given classification and a given contingency, so that P, p and x are equal respectively to $[P]$, $[p]$ and $[x]$, each multiplied by the same constant, which may be called a. In equation (24) if for P, p and x are substituted $a[P]$, $a[p]$ and $a[x]$, respectively we have

$$z = \frac{[x] - [P]}{[p] - [P]} = [z] = \frac{[P]n}{[P]n + \frac{K}{a}},$$

From this it appears that $[z]$, the percentage of the difference between the manual *rate* and the indicated *rate* which is allowed upon adjustment, is given by an expression of the same form as equation (24); equation (24) may therefore be interpreted in terms of rate as well as in terms of hazard, the only difference being with regard to the value of the constant K.

In practice K must be determined by judgment. This will be treated by Mr. Michelbacher. If in equation (24) P is treated as a rate and n as the number of year-workers exposed Pn will be earned premiums. P is obtained by the application of manual or manual and schedule; n, the number exposed, is obtainable from the payroll exposure.

It will be observed that there are no artificial stops such as neutral zones or maximum allowances in connection with this theory. Complete control is found in the formula itself. The only artificial stop that is necessary is a minimum to exclude risks so small that the cost of rating would be out of proportion to the results produced.

The theory developed in this paper contemplates independent occurrences of a simple contingency such as death. Catastrophes are by the nature of the hypothesis excluded. It is obvious as a matter of practice that some concessions must be made to practical conditions on both these points. We cannot insist that the accidents shall be entirely independent and in practice we are not dealing with simple contingencies.

It was found feasible to split the contingencies into two groups, in the first death and permanent total disability, in the second all other losses. Each of these groups is treated separately and the final rate is secured by addition of the two adjusted rates. Similarly it was found satisfactory to exclude the excess of catastrophic losses above a certain point.

A word should be added with regard to the relationship between experience rating and schedule rating. There has never in the past been any conscious and well-considered effort to combine manual rating, schedule rating and experience rating into a single consistent system; in fact it has been generally, although reluctantly, recognized that schedule rating and experience rating were to a considerable extent different ways of doing the same thing, and in effect they have doubtless overlapped; experience rating approaching the problem from the retrospective point of view, schedule rating from the prospective point of view. There has been a certain fiction that, as the proper field of schedule rating was physical condition as revealed by inspection, so correlatively experience rating should cover the field of the moral hazard which could not be reached by the schedule. Unfortunately for this theory experience does as a matter of fact reflect both moral and physical conditions, so that instead of having one system covering physical condition and one covering moral condition, we have in fact one system covering physical condition alone and one system covering both physical and moral condition.

Each however has its peculiar value. Except in the case of small risks experience rating is doubtless in general the better guide

to the hazard. In the case of small risks, however, schedule rating is the only system that produces substantial variations; it is the only system furthermore whose effect is immediately felt in the rate when a plant is brought into good condition.

The ultimate place of schedule rating depends however not so much upon its primary value in measuring the hazard as upon its secondary value as a basis for the prevention of accidents. It is altogether desirable from the standpoint of public policy that there should be some immediate and perspicuous correlation between physical condition and the cost of accidents, and while schedule rating should be developed so far as possible as an exact measure of the hazard, and for this purpose statistical sources must be drawn upon far more than in the past, nevertheless the development of the schedule must be largely guided by a consideration for its place in public economy.

I believe the time has now come when there can be and there should be a complete reconsideration and readjustment of the manual system, the schedule system and the experience system in the effort to develop one thoroughly concatenated and consistent rating system. This involves the necessity for a thoroughgoing analysis of the logic and philosophy of rating.

An illuminating suggestion was made by Mr. Woodward during the work of the Actuarial Section to the effect that the schedule should be viewed as a* refinement of the manual system of classification.

The manual proceeds by simple enumeration of classes. It is impracticable, however, to follow this method beyond a certain point; the future development of the manual should probably be toward simplification rather than amplification. The schedule by analysis and combination provides a method for carrying the process of classification further. Suppose for instance the schedule recognized three characteristics, each having a bearing upon the hazard and suppose that each of these characteristics had five different quantitative values that it might assume, then the possible variations produced by the schedule and superimposable upon the manual would be 5^3 or 125. The place of experience rating in this theory now appears. Manual and schedule together may be considered still to deal with classes, although classes that are greatly

* This point of view had also been held by Mr. Greene; see p. 72 of Vol. III of the Proceedings of the Casualty Actuarial and Statistical Society.

refined. The experience rating plan, however, deals with the particular risk. We have, therefore, in accordance with the theory developed in this paper, the problem of balancing the class effect against the risk effect. This general point of view seems to indicate one possible basis for a thoroughgoing rating theory; in fact the National Reference Committee has already adopted this point of view by providing that the basic rate for experience rating shall be the manual rate as affected by schedule rating. There are, however, also other points of view.

I hope that the future may see important work done along these lines and that an actuarial theory for workmen's compensation insurance rating may be developed as consistent and well-balanced as that of life insurance and going beyond it in its nicety of measurement.

THE PRACTICE OF EXPERIENCE RATING.

BY

G. F. MICHELBACHER.

The practice as opposed to the theory of experience rating may mean either of two things. It may mean the actual application of a plan to the routine rating of individual risks, or it may imply the development of a practical plan from fundamental theoretical principles. It is the purpose of this paper to deal almost exclusively with the second phase. The subject will be taken to embrace all the interesting considerations found in connection with the formulation of a plan of experience rating from the theory recently developed by the Actuarial Section of the National Reference Committee.*

To a certain extent the theory and practice of experience rating are separate and distinct. The theory of experience rating is fundamental. The practice of experience rating may take on any one of a number of different aspects, depending entirely upon the amount and kind of statistical information available and the particular underwriting considerations to which the plan must give expression. The development of the theory has simplified the practice of experience rating. In the past, experience rating suffered from the lack of a fundamental basis. Then discussions of the subject were, in reality, arguments concerning the practice of experience rating. The scheme or the framework was not fixed; the essential principles had not been reduced to formulae. The various elements were, therefore, matters depending upon the judgment of underwriters and actuaries for their determination.

The theory has narrowed the application of judgment. It is surprising to find that when a point is reached in the practice of experience rating which formerly gave rise to extended discussion, the problem has been so thoroughly analyzed that there is apparently but one solution, the form of which is dictated by the theory and the application of which depends largely upon statistical

* The members of the Actuarial Section are: W. W. Greene, Chairman, B. D. Flynn, G. D. Moore, A. H. Mowbray and J. H. Woodward.

data and only to a limited extent upon actuarial and underwriting judgment. Therefore, instead of an elaborate discussion, a paper on the practice of experience rating today will be a description of the procedure whereby the theoretical basis can be transformed into some practical and workable method.

THE FORM OF EXPERIENCE RATING.

The form of experience rating is represented by the following formula:

$$x = P + z(p - P),$$

where for practical purposes the various elements may be defined as follows:

P = the average manual rate for the risk.

This will be an average rate in all cases, for the reason that no risk is completely described by a single manual classification. The average manual rate for the risk is obtained by weighting the several individual manual rates for the respective classifications with the payroll exposure assigned to each.

p = the rate indicated by the risk's own experience.

Inasmuch as experience rating involves a comparison of p with P, p will be developed from the experience for the risk in exactly the same way that the manual rate for any individual classification is developed from the experience of the classification.

z = the allowed percentage of the difference between the manual and indicated rates.

The form of "z" depends upon the nature of the assumption made in the theory. Practically, "z" may be said to embody all of the mathematical or actuarial theory.

x = the final adjusted rate for the risk.

Inasmuch as experience rating involves a comparison of risk and class experience, it is obvious that P, p and x may be expressed not only in terms of rate or pure premium, but also in terms of premium, provided all factors are treated alike. As a matter of fact, in the practical method of rate modification, it is necessary to use premiums throughout. A comparison is made, finally, of the adjusted premium and the premium computed at manual or schedule rates to determine the experience modification. This in turn is

applied to the individual manual or schedule rates to obtain the adjusted rates for the several classifications involved.* In this paper, for the sake of simplicity, rates will be used exclusively.

It is evident that with this definition of the form of experience rating, the actual construction of a plan is a comparatively direct procedure. It is not as simple as might be expected, however, for there are several practical difficulties to be overcome, and there is still necessity for the exercise of personal judgment because of the limitations of the experience data at present available for the solution of the problem.

Division of the Rating Procedure into Several Parts in Rating Individual Risks.

The first question which presents itself for determination is whether, in practice, the rating procedure as applied to the individual risk should consist in a strict comparison of the entire risk experience with the complete manual rate. That is to say, should there be but a single comparison of risk and class experience or should the comparison be in several parts?

In the development of the theory of experience rating, the factors P, p and x were considered in various ways. At no point, however, were they made to represent the collective hazard of the manual classification or of the risk. A logical analysis of the hazard into several elements was assumed and the theory was developed with reference to one individual element, such as the death hazard.

The total hazard in workmen's compensation insurance arises out of the occurrence of accidents resulting in several different types of injuries. The most common analysis of injuries is one which divides them into four different types—fatal, permanent total, permanent partial, and temporary.

Strictly, the theory would necessitate a separate analysis of each of these elements of the hazard. The necessity for some refinement is evident as the probabilities involved range from one in five to one in ten thousand. It is not conceivable that logical results could be obtained if all these hazards were considered as a unit. On the other hand, it is impracticable to make too much refinement as this would tend to complicate the rating procedure. The problem is, therefore to group those elements which naturally go well

* This procedure is clearly described in the example on page 324.

together because of similarity of probability and thus to simplify the plan as much as possible.

The practical effect of considering all the hazard elements as a unit would be to permit abnormal fluctuations of the adjusted rates for individual risks depending upon the occurrence of those accidents the probability of which is very low. Thus, in the case of a small manufacturing risk a death case is not expected except once in a considerable number of years. If the cost of a death case were permitted to influence the rate in proportionately the same degree as a temporary disability case, the result would be an abnormally high rate as soon as the death case entered the risk experience. This would destroy the equity of the plan. In the final analysis, workmen's compensation insurance is carried by an assured for the purpose of protecting himself against those losses which occur with comparatively low frequency. The occurrence of temporary and permanent partial disability cases is so certain that an assured might, after a period of experience, carry his own risk as regards the cost of such cases. The large element of uncertainty, however, which death or permanent total disability cases present, forces him to protect himself by insurance. It is the function of insurance to distribute the cost of cases of this character so that the burden will not fall too heavily upon one individual. It follows, therefore, that one of the fundamental principles of experience rating is that it should not excessively penalize an assured for the occurrence of an accident which, as regards the individual risk, may be considered fortuitous. The fact that a death or permanent total disability case appears in the experience of a risk is not as good evidence as the presence of a large number of temporary or permanent partial disability cases aggregating the same loss.

It is apparent, therefore, at the outset, that there must be some division of the problem in order that proper relative weights may be assigned to the different types of accidents.

In the Actuarial Section several proposals were considered. In the discussion these were finally narrowed down to two. One of these would have divided the problem into two parts, as follows:

1. (*a*) Death cases.
   (*b*) Permanent partial disability cases.
   (*c*) Major dismemberment cases, such as the loss of a hand, arm, leg, eye, etc.

2. (*a*) Permanent partial disability cases, excluding major dismemberments.
   (*b*) Temporary disability cases, total and partial.
   (*c*) Medical cost.

The other proposal, which was adopted,* provides for two divisions and includes major dismemberments in the second division.

In connection with the first proposal, it may be argued that major dismemberment cases do not occur with great frequency; that they cost as much as many death and permanent total disability cases and that their effect, therefore, would be to produce as much inequity, if they were thrown into the classification of accidents which might be considered normal, as the inclusion of death or permanent total disability cases. The answer to this argument is that no statistical information is available for the purpose of developing the problem along these lines, and that as a matter of fact, the total number of these cases in a state experience of considerable volume would be very slight and the possibility of a single accident of this character falling in the experience of a small risk, and thus creating a serious influence on the adjusted rate, very remote.

Having decided upon a two-way division of the problem, the Actuarial Section next established two separate and distinct formulæ. The first is applied to the hazard represented by fatal and permanent total disability cases, the other to the hazard represented by the remaining cases, namely, permanent partial disability, temporary disability and medical cost. The results of the two formulae are combined to determine the total adjusted rate for the risk.

As a matter of practice, then, the plan of experience rating is applied independently to each division of the hazard and a combination of the results, produced in this manner, is necessary before the final adjusted rate can be ascertained. Symbolically, this procedure may be described as follows:

The general formula for the determination of an adjusted rate is

$$x = P + z(p - P).$$

The adjusted rate for the death and permanent total disability hazards is determined by the following formula:

$$x_1 = P_1 + z_1(p_1 - P_1),$$

* Subsequently, Pennsylvania adopted the first division for use in connection with its plan.

where,

P_1 = the death and permanent total disability partial manual rate for the risk.

p_1 = the death and permanent total disability partial rate indicated by the risk's experience.

z_1 = the experience rating factor.

The adjusted rate for the remaining hazards is then obtained by a similar formula:

$$x_2 = P_2 + z_2(p_2 - P_2).$$

The final adjusted rate, X, is the sum of the two adjusted partial rates:

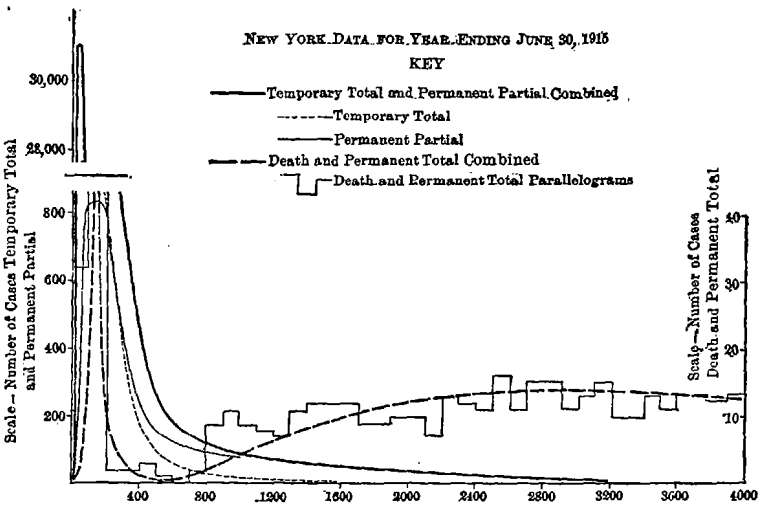
$$X = x_1 + x_2.$$

An estimate which has been made of the probabilities involved in these two divisions indicates that in the first group the range of probabilities is from .0001 to .01 and in the second, from .001 to .5. There is evidently little overlapping.

The validity of the adopted division of the problem is apparent from several statistical studies which have been made of accident experience.

Offhand it would be assumed that if temporary disability cases, permanent partial disability cases, death cases and permanent total disability case were plotted on one graph in accordance with the amount of compensation paid, the maxima of the curves for the individual accident types would appear, starting with the origin, in the order named. It is reasonable to expect, further, that there would be a considerable hiatus between the curves for the temporary and permanent partial disability cases on the one hand and the death and permanent total disability cases on the other, and that it would be possible to demonstrate that the two sets of curves on either extreme might very well each be represented by a single curve or frequency distribution. As a matter of fact, some interesting results were obtained from New York and California experience which in a general way substantiated this reasoning. The results of the investigation for New York* are presented in the following graph which is self-explanatory.

* The New York data, used in this investigation, were secured through the courtesy of Mr. L. W. Hatch, of the State Industrial Commission.



FACTORS FOR THE DIVISION OF MANUAL RATES INTO PARTIAL RATES.

The division of the problem into two parts requires the use of partial manual rates to represent the two elements of the hazard. The second problem, therefore, is the utilization of the available experience for the purpose of obtaining factors to be used for the computation of such partial rates.

It is obvious, first of all, that these factors will vary for the different manual classifications and that it will be necessary to establish more than one set, if proper division of the manual rate is to be made in all cases. Thus, the percentage of the manual rate which is designed to provide for the payment of death losses will be very much different in the textile industry from what it is in the contracting industry, and further there will be many variations within the contracting industry itself.

Some practical method must be devised, therefore, by means of which several sets of factors will be determined for the classifications. Here the problem is limited by the available statistical information. Apparently, one method of procedure would be to have factors for each manual classification. Another would be to produce factors for broad divisions of industry and then to apply them to the rates for all manual classifications within the division. A

third would be to group the manual classifications by rate, to produce factors for each group, and then, by some process of graduation, to translate these group factors into a series of factors to be applicable to the individual rates. If the last method of procedure is followed, the assumption must be made that the relative proportion of losses representing the two elements of the hazard is a function of the size of the rate.

As a matter of practical convenience it has been necessary to employ this third method.

The first approximation to the factor for any classification is obtained by establishing the ratio of the particular loss elements in question to the total losses of an actual experience. The broadest experience available for this purpose is the experience used by the Augmented Standing Committee at the time of the last manual revision as the basis for the establishment of basic pure premiums. If it is assumed that the ratio of death and permanent total disability losses to total losses is a function of the pure premium, factors for the division of the basic pure premium may be obtained by grouping this experience according to the size of the basic pure premiums and establishing ratios for each group.

Permanent total disability losses were not separated in this experience. Neither was it possible to obtain a complete distribution of death losses throughout. It is necessary, therefore, to provide for these deficiencies in the investigation. To provide for the fact that the death losses were not separately stated in all cases, it is necessary to obtain the payroll of all experiences where the death cases were properly segregated and to use this payroll, rather than the total payroll, for the purpose of computing death pure premiums. To provide for the fact that the permanent total disability losses were not separately stated, it is necessary to supply this element by an independent calculation.

Seven groups of classifications according to basic pure premiums have been established for the determination of death ratios, as follows:

Group.	Experience.
I. Less than .05:	
1. Total Payroll	$542,085,485
2. Death Payroll	386,662,207
3. Death Losses	12,497
4. Total Losses	81,707

5. Death Pure Premium, $\left[\frac{(3) \div (2)}{100}\right]$		.003
6. Total Pure Premium, $\left[\frac{(4) \div (1)}{100}\right]$		.015
7. Ratio, [(5)÷(6)]		.200
II. .05 to .20:		
Total Payroll	1,213,317,650	
Death Payroll	851,708,050	
Death Losses	84,957	
Total Losses	1,314,152	
Death Pure Premium		.010
Total Pure Premium		.108
Ratio		.092
III. .21 to .50:		
Total Payroll	1,240,742,468	
Death Payroll	791,470,265	
Death Losses	352,481	
Total Losses	4,148,760	
Death Pure Premium		.045
Total Pure Premium		.334
Ratio		.135
IV. .51 to 1.01:		
Total Payroll	635,979,389	
Death Payroll	483,877,485	
Death Losses	629,815	
Total Losses	4,146,160	
Death Pure Premium		.131
Total Pure Premium		.652
Ratio		.201
V. 1.02 to 2.03:		
Total Payroll	222,844,884	
Death Payroll	164,569,917	
Death Losses	526,988	
Total Losses	3,058,374	
Death Pure Premium		.320
Total Pure Premium		1.372
Ratio		.233
VI. 2.04 to 2.56:		
Total Payroll	105,877,017	
Death Payroll	84,485,998	
Death Losses	447,213	
Total Losses	1,985,152	
Death Pure Premium		.529
Total Pure Premium		1.875
Ratio		.282
VII. 2.57 and over:		
Total Payroll	25,758,587	
Death Payroll	21,124,065	

Death Losses	201,093
Total Losses	738,786
Death Pure Premium	.952
Total Pure Premium	2.868
Ratio	.332

The results of these computations are repeated below, in simplified form:

Group.	Ratio of Death Losses to Total Losses. (Basic Pure Premium Experience).
I	.200
II	.092
III	.135
IV	.201
V	.233
VI	.282
VII	.332

Having ascertained the ratios for death losses, it is next necessary to introduce an estimate of permanent total disability cost. In doing this it must be borne in mind that the experience utilized for the determination of the death ratios has been reduced to the level of the cost of the original Massachusetts Workmen's Compensation Act.

An examination of the differential calculation for this act discloses the following figures:

Cost of death and burial benefits	96,964 weeks' wages
Cost of permanent total disability benefits	22,618 weeks' wages
Total cost	119,582 weeks' wages

Assuming the accuracy of the differential calculations, if the total cost of these benefits is desired and the death cost is given, the total cost may be determined by increasing the death cost 23.3 per cent.

The differential calculations rest upon the assumption that the distribution of accidents according to severity is the same for all industries. There is, therefore, no means whereby the relationship between death and permanent total disability cost can be ascertained by industries. Consequently, it is necessary to assume that the ratio of permanent disability losses to death losses is constant for all classifications. Proceeding upon this basis, death and permanent total disability factors can be obtained by increasing the death factors for each group 23.3 per cent. If this is done the following table of factors will be the result:

Group.	Death and Permanent Total Disability Factors. (Basic Pure Premium Experience.)
I	.246*
II	.114
III	.166
IV	.248
V	.288
VI	.348
VII	.409

Given this table, the corresponding table of ratios for "all other" indemnity and medical losses may be obtained by taking the complement of the value for each group as follows:

Group.	"All Other" Indemnity and Medical Factors. (Basic Pure Premium Experience.)
I	.754
II	.886
III	.834
IV	.752
V	.712
VI	.652
VII	.591

These tables contain factors which can be applied to the basic pure premiums to obtain partial pure premiums for the two loss elements in question. They represent the basis for the construction of a curve from which factors for each individual pure premium symbol have been obtained by graphical interpolation. The details of this transformation need not be described here, as the values for the groups indicate, in a general way, what the trend is.

The next step in the problem is to translate these factors into corresponding factors for any state.

Tables of factors for any state may be computed from the basic tables by a simple calculation. Let us assume that the following information is available:

1. Death and permanent total disability losses on the basic pure premium level.
2. Total losses on the basic pure premium level.
3. Death and permanent total disability partial law differential for each state.
4. Complete law differential for each state.

* This particular factor is abnormal and has been modified for practical use. The modification is not introduced here and the actual results of the experience are used throughout.

If the death and permanent total disability losses, on the basic pure premium level, were multiplied by the proper death and permanent total disability partial law differential, the result, theoretically, would represent death and permanent total disability losses under the state act in question; likewise if the total basic losses were multiplied by the complete differential the result would be the theoretical total losses for the given state. The ratio of the transformed death and permanent total disability losses to the total losses would then represent the proper factor to employ in dividing the manual rates of the state in question into partial rates. The death and permanent total disability factor for the state of New York, for example, would be obtained by the following:

$$\frac{[\text{D.\&P.T.D. losses (basic state)}] \times [\text{D.\&P.T.D. partial differential (N.Y.)}]}{[\text{Total losses (basic state)}] \times [\text{Complete differential (N. Y.)}]}$$

or

$$\left[\frac{\text{D.\&P.T.D. losses (basic state)}}{\text{Total losses (basic state)}}\right] \times \left[\frac{\text{D.\&P.T.D. partial differential (N.Y.)}}{\text{Complete differential (N. Y.)}}\right]$$

However, the first part of this expression is nothing more than the ratio for the basic pure premiums which already has been established. It remains, therefore, to establish the ratio of the death and permanent total disability partial differential to the complete differential for New York. The application of this law differential ratio to the death and permanent total disability factor in the basic table will produce the corresponding state factor. For example, the death and permanent total disability partial differential for New York is 2.48. The complete differential for New York is 1.89. The ratio is 1.31. If the death and permanent total disability factor for the basic pure premiums is multiplied by this value, the result will represent the corresponding factor to employ in the division of the New York manual rates. If this is done, the following table of factors will be obtained:

Group.	Death and Permanent Total Disability Factors (New York).
I	.322
II	.149
III	.217
IV	.325
V	.377
VI	.456
VII	.536

The factors for the computation of the "all other" indemnity and medical partial rate will then be obtained by taking the complement of each value in this table as follows:

Group.	"All Other" Indemnity and Medical Factors (New York).
I	.678
II	.851
III	.783
IV	.675
V	.623
VI	.544
VII	.464

It may be argued that these factors are obtained by a method which is based largely upon assumptions. However, it can be demonstrated that the results are not far out of line when compared with actual experience. For instance, corresponding ratios based upon New York Schedule "Z" experience for policy year 1914 may be determined as follows:

RATIOS OF DEATH AND PERMANENT TOTAL LOSSES TO TOTAL LOSSES BY PURE PREMIUM GROUPS.

1. Group.	2. Basic Pure Premiums.	3. Total Losses.	4. Death and Permanent Total Losses.	5. Ratio of Column 4 to Column 3.
I..	Less than .05	$ 13,261	$ 1,841	.139
II..	.05– .20	399,927	77,540	.194
III..	.21– .50	1,340,118	311,517	.232
IV..	.51–1.01	1,458,502	476,969	.327
V..	1.02–2.03	1,246,665	424,843	.341
VI..	2.04–2.56	613,917	291,318	.474
VII..	2.57 and over	380,927	189,796	.498

If the ratios in column 5 of the above table are compared with the ratios established for experience rating purposes, close similarity will be noted. As a matter of fact, if the experience rating factors are projected into the total New York losses for the several groups, it will be found that the expected death and permanent total disability losses, on this basis, exceed the actual death and permanent total disability losses of the Schedule "Z" experience by the narrow margin of $8,970.

What Manual Rate should be Employed as the Basis for Experience Rating?

It is a question whether or not, inasmuch as experience rating involves the use of past experience, the manual rate used for the determination of the experience modification should be the one actually charged during the time the experience was developed. Thus, if experience rates are to be determined in 1918, experience may be available for policy years 1915, 1916 and 1917, and a comparison will be made of the risk experience and a manual rate. The question is whether in this comparison the manual rates which obtained in 1915, 1916 and 1917 should be used, or whether the manual rate at present in existence—the manual rate on the basis of which the policy will be written—should be employed.

So far as this point is concerned, it is only necessary to say that rates in workmen's compensation insurance are becoming more and more accurate as time passes. With each manual revision the volume of data increases, greater knowledge is gained concerning the hazards of the classifications, and the underwriting procedure becomes more firmly established.

It is evident that the very latest manual rate is the most accurate so far established. The manual rate to be used for experience rating purposes, therefore, should be the *present* manual rate.

This simplifies the problem; it provides a single criterion rather than several, for in workmen's compensation insurance the manual rates have changed, on the average, once a year and it follows, therefore, that if the manual rates of the past were used there would be as many different rates for each classification as there were changes during the experience period.

Modification Factors.

Experience rating involves a comparison of risk and classification experience, or what is the same thing, a comparison of the rate indicated by the risk's experience with the manual rate.

The rate used for experience rating purposes is the present manual rate. This rate represents certain cost conditions differing from those represented by the losses of the risk. For instance, it is known that the cost of compensation has gradually increased since the inception of compensation laws. The present manual rate rep-

resents the cost conditions assumed to exist at the present time. The experience losses reflect the conditions which obtained in the past. Again, the statutory provisions of workmen's compensation laws are changing rapidly. The present manual rate measures the cost of the present benefits of the state law. The experience losses may measure the cost of benefit provisions entirely different because of intervening amendments. Further, the industrial conditions which affect the cost of compensation and which are reflected in the present manual rate may be entirely dissimilar to those which existed at the time the risk experience was accumulated.

If the manual rate and the rate indicated by the experience of the risk are to enter into the determination of the experience modification, it is essential that these rates should be comparable, that is, that they should represent the same cost conditions. For this reason modification factors must be introduced to take account of such differences between the cost conditions represented by the experience losses and those reflected in the present manual rate which can be detected, analyzed and evaluated. In addition, because the manual rate contains a loading for management expenses, a similar factor must be applied to the risk pure premium.

The factors which are employed to produce the indicated risk rate from the experience losses are, therefore, of two kinds: first, factors which measure differences in cost conditions between the experience losses and the present manual rates; second, a factor to provide the necessary loading for management expenses, taxes and profit.

Factors of the first class take into consideration the following elements:

(*a*) A possible underestimate of the outstanding losses of the risk experience.
(*b*) Changes in the interpretation and administration of the compensation law and in the attitude of claimants toward the compensation law.
(*c*) Changes in industrial conditions which may affect the production of accidents and their severity.
(*d*) Amendments to the compensation law.

The loading for management expenses, taxes and profit is merely a duplication of the corresponding factor employed in the preparation of state rates.

The indicated risk rate will, therefore, be obtained as follows:

$$p = \frac{100\ LM}{R}$$

where

p = the indicated risk rate, for any hazard element, per hundred dollars of payroll exposure.

L = the actual risk losses, paid and outstanding, for the hazard element in question.

M = the modification factor to reflect the difference between the cost conditions represented by the experience and the present manual rate, and to provide a loading for management expenses, taxes and profit.

R = the payroll for the risk.

As a matter of fact, there must be a value of "M" for every policy year, and in addition, distinction must be made between the value of "M" for indemnity losses, and for medical losses. The reasons for this arise out of the fact that amendments to compensation laws do not always affect the medical benefits. It is also difficult to estimate medical losses which have been incurred but not paid. Because of this condition the medical cost of the risk is based upon the actual medical losses paid. The paid medical losses for years preceding the current year represent substantially the medical cost for the reason that medical claims mature rapidly and are usually paid in a lump sum and not over an extended period as in the case of indemnity benefits. For the last year, however, it is obvious that if the actual paid medical losses are taken as the basis, a considerable factor to provide for outstanding losses must be applied before the losses are used in the calculation. For these reasons the modification factors for medical losses, although they correspond in general with those used to modify the indemnity losses, differ in some degree.

The following modification factors are given as an example:

TO BE APPLIED TO INDEMNITY LOSSES.

Policy Year.	Underestimate of Outstanding Losses.	Changing Conditions			Management Expenses, Taxes and Profit.	Total.
		Administrative; Attitude of Claimants.	Industrial Conditions.	Amendments to Act.		
1914..	1.00	1.09	1.10	1.04	1.64	2.04
1915..	1.02	1.04	1.10	1.04	1.64	1.99
1916..	1.02	1.02	1.05	1.03	1.64	1.76
1917..	1.08	1.00	1.00	1.00	1.64	1.77

TO BE APPLIED TO MEDICAL LOSSES.

Policy Year.	Underestimate of Outstanding Losses.	Changing Conditions			Management Expenses, Taxes and Profit.	Total.
		Administrative; Attitude of Claimants.	Industrial Conditions.	Amendments to Act.		
1914..	1.00	1.09	1.10	1.75	1.64	3.44
1915..	1.00	1.04	1.10	1.75	1.64	3.28
1916..	1.10	1.02	1.05	1.50	1.64	2.76
1917..	1.25	1.00	1.00	1.02	1.64	2.09

"z" FORMULAS.

Formerly, a discussion of experience rating was incomplete without lengthy reference to such subjects as maximum debits and credits, the graduation of debits and credits and the neutral zone. These artificial limitations were necessary because, in the absence of a well-conceived and thoroughly balanced fundamental basis of experience rating, it was essential that safeguards should be thrown about the plan in order that illogical and abnormal results might be avoided. Naturally, because of their importance, these subjects were always matters for protracted discussion and argument. Now that we have a theory of experience rating, they drop out of sight, for the "z" factor provides all the working power of the experience rating formula.

The determination of the form of "z" is an actuarial problem and properly belongs to the theory of experience rating. The actual application of the "z" formula, however, and the establishment of a practicable method of determining "z" are matters which fall within the scope of this paper.

Three forms of z were considered by the Actuarial Section:

I. The second approximation;*

* See Mr. A. W. Whitney's paper, formula (15A).

II. The first approximation where

$$z = \frac{A}{A + P - P^2}$$

and

$A = N\epsilon^2$.

P = the hazard index for the elements under consideration. (Or, from a practical point of view, the partial manual rate for the hazard elements involved.)

N = the number of employees exposed. (Or, from a practical point of view, the payroll exposure for the risk.)

ϵ = a constant of the general form CP^t.

III. Another form of first approximation where

$$z = \frac{PN}{PN + K}$$

and

PN = the gross premium for the risk for the hazard elements under consideration.

K = a constant determined by judgment.

From a theoretical point of view, it is desirable that an experience rating plan should be so designed that it will properly measure every conceivable variation in hazard which may be found in practice. From this point of view there is no limit to the complications which may be introduced in the formulae. As a matter of practice, however, the first essential is simplicity, for the reason that those who actually apply experience rating are not familiar, as a general rule, with mathematical terms or actuarial formulae.

From a practical point of view, therefore, in deciding upon a law for "z," it is necessary to choose a law which produces the most accurate results in the greatest number of cases and which at the same time is simple not only from the standpoint of the mathematics involved but also with reference to its interpretability by underwriters, raters, agents and assured.

The so-called second approximation form was found to be impracticable because it was too complicated. It was never seriously considered, for it was found impossible to reduce the formula to such terms that it could be readily applied in practice. It was thought, at one stage of the proceedings, that it might be employed

to treat certain abnormal cases which would not receive logical and equitable treatment by a method of first approximation. But this idea was dropped later as unnecessary.

A form of first approximation was, therefore, resorted to as a practicable method for the calculation of "z." In Mr. Whitney's form the essential problem centered around the determination of a law for "ϵ." As a matter of theory, "ϵ" should be determined by a statistical investigation. However, for this purpose it would be necessary to have a large number of individual risk experiences and to know more about the true hazard of individual risks than we do at present. Several laws were, therefore, assumed. Experiments were also made with a view to ascertaining whether it was necessary to have two laws of "ϵ," one for each element of the hazard. In these investigations underwriting and actuarial judgment was relied upon entirely as a guide. Finally, the following laws which seemed to produce results most nearly in conformity with good actuarial and underwriting judgment were taken as a basis for tests:

For the death and permanent total disability hazard,

$$\epsilon^2 = .0006P^{5/4};$$

For the "all other" indemnity and medical hazard,

$$\epsilon^2 = .0015P^{5/4}.$$

Tables were then constructed by means of which values of "z," based upon these two laws, might be obtained by inspection. These were two-way tables, so arranged that, given the payroll exposure for the risk and the partial manual rate for the hazard in question, the value of "z" might be readily located.

Sample values, selected from the Illinois tables, are given below for illustration.

D. & P. T. D.

$$z = \frac{N\epsilon^2}{N\epsilon^2 + P(1-P)}. \qquad \epsilon^2 = .0006P^{5/4}.$$

Payroll.	D. and P. T. D. Rate.										
	.018	.036	.091	.1[illegible]	.168	.218	.294	.563	.750	1.164	1.455
50,000.....	.003	.003	.004	.004	.005	.005	.005	.006	.007	.008	.008
100,000.....	.006	.007	.008	.009	.009	.010	.011	.013	.014	.015	.016
500,000.....	.026	.032	.038	.042	.045	.048	.051	.060	.065	.072	.075
1,000,000.....	.051	.062	.073	.081	.086	.091	.098	.114	.122	.134	.140
5,000,000.....	.216	.247	.280	.301	.317	.331	.347	.386	.405	.430	.444

"ALL OTHER"

$$z = \frac{N\epsilon^2}{N\epsilon^2 + P(1-P)}. \qquad \epsilon^2 = .0015P^{5/4}.$$

Payroll.	"All Other" Rate.										
	.082	.164	.409	.614	.832	1.082	1.456	1.687	2.250	2.836	3.545
50,000.....	.023	.028	.036	.041	.044	.048	.053	.056	.064	.072	.081
100,000.....	.046	.055	.069	.077	.084	.091	.100	.106	.120	.133	.150
500,000.....	.194	.224	.269	.294	.314	.333	.366	.371	.402	.432	.466
1,000,000.....	.325	.367	.425	.456	.479	.501	.526	.541	.575	.604	.636
5,000,000.....	.703	.740	.784	.805	.818	.831	.845	.853	.869	.882	.896

The "z" values were then tested by actual application to 190 risks for the state of Illinois. On the whole, the results were entirely satisfactory, but the Section still had to make a decision concerning the practicability of the formula. Depending as it did upon two elements and requiring a two-way table for its application, there was some question as to whether or not values of "z," based upon laws of "ϵ," should be taken. It was decided that if any other first approximation formulae, producing results substantially in accordance with those of the "ϵ" formulae, could be developed, they should be adopted, provided it could be demonstrated that they were more simple.

The special case of the first approximation where

$$z = \frac{PN}{PN + K}$$

was, therefore, tested with the idea of ascertaining how closely, if at all, the results would approximate those obtained by the "ϵ" formulae. It was discovered that, with the proper choice of constants, the fit was reasonably close, although it was impossible to produce absolutely corresponding results in all cases. The Section decided, however, that the simplicity of the formula overbalanced the fact that it did not produce the very best result in every individual case.

The constants which were finally chosen for the state of Illinois are as follows:

For the death and permanent total disability hazard	18,000
For the "all other" indemnity and medical hazard	8,000

For the purpose of comparison and in order that the general fit of this and the other form of first approximation may be observed,

simplified tables of "z" for the two hazard elements are given below.

D. & P. T. D.

$$z_1 = \frac{P_1 N}{P_1 N + 18000}.$$

Payroll.	D. and P. T. D. Rate.										
	.018	.036	.091	.136	.168	.218	.294	.563	.750	1.164	1.455
50,000.	.000	.001	.003	.004	.005	.006	.008	.015	.020	.031	.039
100,000.	.001	.002	.005	.007	.009	.012	.016	.030	.040	.061	.075
500,000.	.005	.010	.025	.036	.043	.057	.076	.135	.172	.244	.288
1,000,000.	.010	.020	.048	.070	.085	.108	.140	.238	.294	.393	.447
5,000,000.	.048	.091	.202	.274	.318	.377	.450	.610	.676	.764	8.02

"All Other"

$$z_2 = \frac{P_2 N}{P_2 N + 8000}.$$

Payroll.	"All Other" Rate.										
	.082	.164	.409	.614	.832	1.082	1.456	1.687	2.25	2.836.	3.545
50,000.	.005	.010	.025	.037	.049	.063	.083	.095	.123	.151	.181
100,000.	.010	.020	.049	.071	.094	.119	.154	.174	.220	.262	.307
500,000.	.049	.093	.204	.277	.342	.403	.476	.513	.584	.639	.689
1,000,000.	.093	.170	.338	.434	.510	.575	.645	.678	.738	.780	.816
5,000,000.	.339	.506	.719	.793	.839	.871	.901	.913	.934	.947	.957

COMPUTATION OF "K" VALUES FOR THE COMPENSATION STATES.

Having determined the form of "z," the problem next to be solved is that of computing constants for the "z" formulas for the different states.

The basic principle assumed in this work is that, in general, the "z" value for a particular risk should be the same in all states, that is, that the percentage of the deviation allowed for a given risk should be independent of the state in which the risk is experience rated. Inasmuch as the premium for the hazard element varies from state to state, it is neecssary to make a corresponding modification of the constants in order that there may be consistency in the values of "z."

The "z" formulas are:

Death and permanent total disability

$$z_1 = \frac{P_1 N}{P_1 N + K_1};$$

"All other" indemnity and medical cost

$$z_2 = \frac{P_2 N}{P_2 N + K_2}.$$

Given Illinois values of 18,000 and 8,000 for K_1 and K_2, respectively, the problem is to determine corresponding values for the remaining compensation states.

In solving this problem the following notation will be adopted:

(pp) = basic pure premium,
P = Illinois manual rate (Illinois partial manual rates will then be designated by P_1, P_2),
M = Illinois multiplier,
L = Illinois law differential,
D = Illinois death and permanent total disability differential,
A = Illinois "all other" indemnity and medical law differential,
P' = state manual rate (state partial manual rates will then be designated by P_1', P_2'),
M' = state multiplier,
L' = state law differential,
D' = state death and permanent total disability law differential,
A' = state "all other" indemnity and medical law differential.

Consider the "z" formula for the death and permanent total disability hazard. Let z_1 refer to Illinois and z_1' to any other compensation state. Then in accordance with the fundamental assumption,

$$z_1 = z_1' \text{ or,}$$

$$\frac{P_1 N}{P_1 N + 18{,}000} = \frac{P_1' N}{P_1' N + K_1},$$

from which

$$\frac{N}{N + \frac{18{,}000}{P_1}} = \frac{N}{N + \frac{K_1}{P_1'}}.$$

It follows, therefore, that

$$\frac{K_1}{P_1'} = \frac{18{,}000}{P_1} \quad \text{or} \quad K_1 = \frac{18{,}000 P_1'}{P_1},$$

where

$$P_1' = \frac{M'(pp)D'}{L'} \quad \text{and} \quad P_1 = \frac{M(pp)D}{L};$$

therefore,

$$K_1 = 18{,}000 \frac{M'}{M} \times \frac{L}{L'} \times \frac{D'}{D}.$$

Evaluating for Illinois,

$$M = 3.32,$$

$$L = 1.37,$$

$$D = 1.38.$$

Substituting these values in the general formula,

$$K_1 = 5382 \frac{M'}{L'} \times D'.$$

By a similar process,

$$K_2 = 2428 \frac{M'}{L'} \times A'.$$

It will be seen that all that is necessary for the determination of K_1 and K_2 for any state is the state multiplier, the state law differential (complete) and the state partial law differentials for death and permanent total disability and "all other" indemnity and medical losses.

If this formula is applied to New York, for instance, the constants, in round numbers, will be:

$$K_1 = 28{,}800,$$

$$K_2 = 8{,}600,$$

and the "z" formulas will be,

for death and permanent total disability,

$$z_1 = \frac{P_1 N}{P_1 N + 28{,}800}.$$

for "all other" indemnity and medical cost,

$$z_2 = \frac{P_2 N}{P_2 N + 8{,}600}.$$

The use of these formulas does not require tables, although the results might be worked out in advance and presented in one-way tables. As a matter of practice, all that is necessary is the determination, for each hazard element, of the partial premium at manual rates. Once this has been determined the value of "z" can be ascertained by substituting this partial premium in the appropriate "z" formula. To take a simple example, if a partial "all other" indemnity and medical premium of 8,600 were obtained in the case of an individual risk in New York, the value of "z" would be 50 per cent. That is to say, in this case, 50 per cent. of the difference between the indicated and manual rates would be allowed as the experience modification for "All Other" indemnity and medical cost. Thus, if there were no losses at all, the plan, on this part of the rate, would produce a 50 per cent. credit.

QUALIFICATIONS.

In the plans that have been used in the past there have been three important qualifications: a qualification as to the experience period and certain limitations concerning the payroll and premium required before a risk could be experience rated.

The reasons for these qualifications were quite obvious. A certain experience period was required to insure a sufficiently long observation of the risk experience to make certain that it was normal and not the result of chance. The payroll requirement was used to insure the application of the plan only to such risks as were of sufficient size to produce a representative and dependable experience. The premium limitation was used to bring in the hazard of the risk and to insure that a sufficient expectation was represented by the experience data to warrant the expense and trouble of determining an experience modification. It was also used as a measure of the dependability of the experience, although not to the same extent as the payroll.

In the new plan, there will be a qualification as to the experience period. In general, it may be said that the minimum experience period will be two years and the maximum four years. Two years was chosen because of the opinion that a period of two years is necessary to render certain the securing of a representative experience. Four years was taken in the belief that past experience more than four years old is of little or no value in the determination of future rates because of the constantly changing conditions in workmen's compensation insurance.

The payroll limitation has been dropped. In the past, a payroll limitation was necessary, just as other artificial limitations were necessary, to guard against abnormal results in exceptional cases. The new theory of experience rating will not produce inconsistent results even in the case of the smallest risks. It is no longer necessary, therefore, to set up a limit which will exclude certain risks because of doubt as to the dependability of the risk experience.

A premium qualification still remains and serves a valuable purpose. While the plan will produce a logical result even in the case of a very small risk, as a matter of practice, this will be an insignificant departure from the manual rate and it comes down to a question of whether the expense of computing an experience modification is warranted by the result. It is necessary, therefore, to depart entirely from the question of the accuracy and to decide upon a premium which will be considered sufficient to warrant the expense and labor of computing an experience modification. The question is purely an administrative one rather than an actuarial or statistical one. In the new plan, a premium limitation of $500 for the minimum experience period or roughly $300 per year, is required before a risk can be experience rated.

Experience to be Used.

Experience rating involves the use of experience for the risk, or in other words, the use of a loss history. Inasmuch as the plan is to be applied only for the modification of workmen's compensation rates, it is obvious that no employers' liability experience should be used. This requirement, coupled with the minimum experience period limitation, makes it impossible to employ experience rating in any workmen's compensation state until the date of the second anniversary of the workmen's compensation act.

In addition, only such experience as can be obtained from insurance carriers is admitted. Thus, experience rating cannot be done upon the basis of experience submitted by a self-insurer. The reason for this qualification is that the compilation of statistics in workmen's compensation insurance is a very technical matter. To be dependable, statistical information must be produced under the proper conditions, with adequate and intelligent supervision. It is probable that the experience of a self-insurer will not represent the same careful methods of compilation as the experience of an insurance carrier, whose business it is to maintain records of this

character. Furthermore, such experience as the self-insurer has available, has been kept for purposes which in no case correspond to the requirements of the experience rating plan. Therefore, its use is not permitted. Thus, in the case of a new risk entering the insurance field, experience rating cannot be applied until the second anniversary of the issuance of a policy of insurance.

Treatment of the Catastrophe Hazard.

In the theoretical development of experience rating, the theory of probabilities used as the basis for the formulae is the theory of independent events. A catastrophe is not an independent event. The theory, therefore, does not contemplate the inclusion of losses of this character.

From a practical point of view this would require either the entire disregard of catastrophies or the elimination of a certain excess in every case, retaining, for experience rating purposes, only that part of a catastrpohe loss which might be considered normal. In either event, it is necessary to give special consideration to those classifications which present a serious catastrophe hazard. In these cases, the normal losses, when compared with the manual rate, will always indicate a low loss ratio because of the large element in the rate providing for the occurrence of catastrophies.

For instance, in the case of powder manufacturing, the normal losses are very low as compared with the manual rate. The normal loss ratio is fictitious, for a large part of the manual rate in this case is devoted to the accumulation of a fund from which heavy losses will be paid when they occur. Therefore, if the plan were applied to this rate without modification, too great an experience credit would be permitted, too much of the premium would be returned and the catastrophe reserve would be impaired.

The Actuarial Section has recommended that a special list be made of all classifications which are considered to present an exceptional catastrophe hazard. In these cases, a part of the premium will be set aside for the catastrophe reserve and will not be subject to experience modification. This is equivalent to making a three-way division of the manual rate. First, the manual rate is divided into the normal rate and the rate to provide for the catastrophe hazard. The catastrophe rate is set aside and is subject to no modification. The normal rate is then divided into the two hazard elements and rated in accordance with the plan. In this way, a ficti-

tious loss ratio is avoided and the adjusted rate reflects the normal hazard of the risk as indicated by the ordinary losses.

In addition, it has been provided that each catastrophe (that is, an individual accident in which five or more people are involved and the cost of which is not less than $12,500) shall be singled out for special consideration. The loss in any case of this character in excess of $12,500 will be eliminated entirely. The cost to the limit of $12,500 will be considered as a normal loss and will be used in the determination of the adjusted rate.

Combination of Experience and Schedule Rating Modifications.

In manufacturing risks both schedule and experience rating are used as methods of rate modification. It is necessary, therefore, to have some method of combining the results of the application of the two plans.

In the past, the usual method of combination was to permit the algebraic addition of the schedule and experience rating modifications with an arbitrary limit of 40 per cent. Expressed in terms of a formula, this is equivalent to the following:

$$R = M[1 - (S + E)],$$

where

R = the final adjusted rate,
M = the manual rate,
S = the schedule modification, expressed decimally,
E = the experience rating modification, expressed decimally.

Thus, in the case of a manual rate of $1, a schedule credit of 15 per cent. and an experience debit of 5 per cent., the final adjusted rate would be $.90.

This method is obviously incorrect, if for no other reason than that it leads to a duplication of credits or debits, as the case may be. Proper weight is not given to either the schedule or experience rating modification, nor is there any logical method of combining the results.

During the recent discussion of experience rating, the theory was advanced that schedule rating might be looked upon as a method of refining the classification of a risk and that experience rating should not be applied until after the schedule had first been used to adjust the manual rate. In other words, a logical sequence of rat-

ing was established. In this sequence the manual comes first, the schedule next and the experience rating plan last.*

A risk is presented for rating. The manual is consulted. A classification is found which describes the risk. The rate for this classification, and the terms of the classification itself for that matter, are approximate. With a single manual and a limited number of classifications, this is bound to be the case. To make a better approximation to the actual classification and hazard of the risk, the schedule is applied to the manual rate. If there are peculiar physical conditions in the risk which cause it to be different in some respect from the average or typical risk described by the classification, the schedule measures this difference and reflects it in the schedule modification, so that when the schedule has had an opportunity to measure the risk for the rate which should be charged, a much more accurate estimate is obtained than the manual rate. The experience rating plan is then applied, not to the manual rate, but to the manual rate adjusted by schedule rating. The result is the final adjusted rate. In this method of procedure, the steps are logical and it can be demonstrated that there is little or no duplication of debits or credits.

This method was chosen for the new experience rating plan. It may be demonstrated by the following formula:

$$R=[M(1-S)](1-E),$$

it being understood, of course, that $[M(1-S)]$ will be obtained before the experience rating plan is applied. Thus, in the case of a manual rate of \$1.00, a schedule credit of 10 per cent. will make the rate adjusted by schedule \$.90. Ninety cents will then be used as the basis for the determination of the experience modification. If the experience modification, on this basis, proves to be a 5 per cent. debit, the final adjusted rate will be \$.945.

Example of the Application of the Plan to the Problem of Rating an Individual Risk.

In order that the reader may appreciate the practical significance of the matters described in this paper, an example is given of the actual application of the new plan of experience rating to the

* It should not be assumed that this is the only theory on this subject. A second theory, which can be substantiated by logical analysis, would place experience rating second and schedule rating as the final step in the rating scheme.

problem of modifying the rates for an individual risk. For this purpose an actual Illinois risk has been chosen which involves the following manual classifications:

2501—Clothing Manufacturing,

8810—Clerical Office Employees (not otherwise classified),

8742—Salesmen (Outside), Collectors and Messengers.

Experience is available, for the risk, for the period from January 14, 1914, to October 14, 1917. The expiration date of the policy is January 14, 1918, but because experience rates are promulgated prior to the date of expiration, the experience has been brought down to a date ninety days prior to that date. For this period, the payroll exposure by classifications is as follows:

Classification Number.	Payroll Exposure.
2501	$1,438,607
8810	174,868
8742	73,843

In this case, let us assume that the schedule rating plan will not be applied. This assumption is contrary to fact, because this risk is one which is subject to schedule rating and it would, therefore, receive such treatment. The assumption is made for the purpose of simplifying the example.

The present manual is consulted and Illinois manual rates are determined for the three classifications involved. The premium at manual rates for the risk is then computed as follows:

Classification Number.	Payroll Exposure.	Present Manual Rate.	Premium.
2501	$1,438,607	$ .33	$4,747
8810	174,868	.11	192
8742	73,843	.19	140
Totals	$1,687,318		$5,079

If the total premium at manual rates is divided by the total payroll exposure, the average rate for the risk will be found to be $.301. If this rate is used as an item of entry in the table of factors, the division of the premium at manual rates into two parts will be ascertained to be as follows:

Hazard Element.	Factor.
Death and Permanent Total Disability Cases	.149
"All Other" Indemnity Cases and Medical Cost	.851

Accordingly, the two separate parts of the total premium at manual rates will be:

Hazard Element.	Premium.
Death and Permanent Total Disability Cases	$757
"All Other" Indemnity Cases and Medical Cost	4,322

Turning now to the losses of the risk, we find, first of all, that there are no death or permanent total disability losses. The exhibit of such losses, as were incurred, by policy years and the method of translating these losses into terms of premium so that a comparison may be made of the risk experience and the manual premium will be as follows:

Policy Year.	"All Other" Indemnity Losses, Excluding Medical Losses.			"All Other" Medical Losses.			Total Indicated "All Other" Premium.
	Actual Losses.	Modification Factors.	Indicated Premium.	Actual Losses.	Modification Factors.	Indicated Premium.	
1914....	$ 53	2.25	$119	$ 61	2.25	$137	$256
1915....	46	2.10	97	104	2.05	213	310
1916....	79	1.89	148	99	2.01	199	347
1917....	0	1.94	0	33	2.24	74	74
Totals.	$178		$364	$297		$623	$987

The next step is the substitution of the available data in the two experience rating formulae.

Rating of Death and Permanent Total Disability Elements.

The formula for this division is,

$$x_1 = P_1 + z_1(p_1 - P_1),$$

where

x_1 = the adjusted D. & P. T. D. premium,

P_1 = the manual D. & P. T. D. premium,

p_1 = the indicated D. & P. T. D. premium (from risk's experience),

z_1 = the experience rating factor for D. & P. T. D. elements.

In this case,

$$z_1 = \frac{[\text{Manual D. \& P. T. D. premium}]}{[\text{Manual D. \& P. T. D. premium}] + K_1}.$$

K_1 is found from the Illinois tables to be 18,000.

Assembling these various items and substituting them in the formula at the proper places produces the following:

$$x_1 = \$757 + \frac{(757)}{(757 + 18{,}000)}(0 - \$757),$$

from which

$$x_1 = \$727.$$

Rating of "All Other" Elements.

The formula for this division is,

$$x_2 = P_2 + z_2(p_2 - P_2),$$

where the symbols correspond to those in the D. & P. T. D. formula.

In this case,

$$x_2 = \frac{[\text{Manual "All Other" premium}]}{[\text{Manual "All Other" premium}] + K_2}.$$

Upon consulting the Illinois tables, K_2 is found to be 8,000.

The determination of the adjusted "All Other" premium is, therefore, as follows:

$$x_2 = \$4{,}322 + \frac{(4{,}322)}{(4{,}322 + 8{,}000)}(\$987 - \$4{,}322),$$

from which

$$x_2 = \$3{,}151.$$

Determination of Final Adjusted Rates.

The total adjusted premium, "X," is then obtained by the following formula:

$$X = x_1 + x_2.$$

Substituting for x_1 and x_2, we find

$$X = \$3{,}878.$$

The premium at manual rates for the risk is \$5,079. The experience rating plan has produced a total reduction in this premium of \$1,201, which expressed in a percentage is equivalent to a credit of 23.6 per cent. This is the final experience modification.

To ascertain the final adjusted rates for the three classifications involved, this percentage is applied to the manual rate for each classification. In his way the following results are obtained:

Classification Number.	Manual Rate.	Experience Rate.
2501	$.33	$.252
8810	.11	.084
8742	.19	.145

THE INDUSTRIAL COMPENSATION RATING SCHEDULE, 1918.*

BY

E. H. DOWNEY.

I.

Schedule rating, as applied to workmen's compensation insurance, practically began with the adoption of the Universal Analytic Schedule.† The Industrial Compensation Rating Schedule of 1916‡ was not merely the successor but the immediate derivative of the Universal Analytic,§ from which it differed only in matters of detail, and not always by any means improved detail. Both the Universal Analytic Schedule and its variant, the Industrial Compensation Rating Schedule of 1916, follow the same fundamental plan and the same broad criticisms apply to both. In what follows, therefore, to avoid constant repetition, both variants are covered by the original and more familiar name.

The Universal Analytic Schedule is designed to rate compensation insurance risks individually upon the basis of certain apparent hazards ascertained by inspection. The hazards to be taken into account are specified in a schedule or list of items to each of

* Special acknowledgment for assistance in the preparation of this paper is due to Mr. R. M. Pennock, of the State Workmen's Insurance Fund of Pennsylvania, a member of the National Reference Committee on Schedule Rating, and to Mr. Herbert G. Wiberg, of the Compensation Inspection Rating Board of New York, Secretary of the Committee.

† The application of schedule rating to compensation insurance was avowedly borrowed from fire insurance and seems to have occurred to several persons at about the same time. A number of rating schedules were, in fact, developed independently—notably the embryonic Massachusetts Schedule of 1913, the Employers' Mutual Schedule (Wisconsin) and the Prudential Casualty Schedule. None of these plans, however, attained any wide use or exercised any perceptible influence on the development of schedule rating.

‡ Adopted by the First Conference on Schedule Rating, New York, 1916.

§ The Coal Mine Rating Schedule of the Associated Companies (1915) was the first important attempt to develop a compensation rating schedule on lines differing radically from those followed by the Universal Analytic.

which a definite value is assigned by way of addition to (charge items) or subtraction from (credit items) the classification (manual) rate or premium. The result is a total rate or total premium for the individual risk which will be less or more than the premium at manual rate according as credit or charge items preponderate in the particular case. Charges are assigned to conditions which are presumed to be more hazardous and credits for conditions which are presumed to be less hazardous than the average for risks of the same industry class. The net aggregate result is expected to be a balance of premium increases and decreases. Where this expectation is not realized, the resultant premium deficit is offset by a loading in manual rates.* The item values are variously expressed: in flat amounts to be added to or deducted from total premium, in cents per $100 of payroll and in per cent. of manual rate. Catastrophe items, such as the hazard of fire or of boiler explosion, are valued in cents per $100 of payroll; morale items, such as safety organization or first-aid provisions, in per cent. of base rate; most other items carry flat values. Thus the employer is charged $.50 for each exposed set screw, $1.00 for an unlighted stair, and $.03 for each linear foot of unrailed balcony: all irrespective both of the number of employees and of the industry classification. The flat credits for general machine guarding, however, vary with the manual rate and the credit for individual motor drive is even a direct per cent. of rate. These different modes or bases of item valuation are recited at length because they have an important bearing upon the practical working of the schedule.

The great merits of the Universal Analytic Schedule are: (*a*) that it provides positive and generally accepted standards for the safeguarding of plant and equipment; (*b*) that it outlines certain effective methods of improving plant morale; and (*c*) that it offers a definite easily calculated pecuniary incentive to the carrying out of the suggested improvements.† The criticisms most often made

* The loading for schedule-rated classifications in 1917 (outside of Massachusetts and Pennsylvania) is nine per cent.

† For discussion and criticisms, of the Universal Analytic Schedule see Hansen, *Proceedings*, Vol. I, pp. 217–226; Rubinow, *ib.*, pp. 209–216; Senior, pp. 227–240; Mowbray, Vol. III, pp. 14–25; Downey, pp. 26–42; Black, p. 266; for a mathematical discussion of schedule rating in general, see Mowbray, *ib.*, Vol. I, pp. 241–249; Whitney, pp. 250–256.

The writer's general views on the principles of schedule rating are set forth in the paper above cited.

are: (1) that the item values have no demonstrable relation to the hazards which they purport to measure, (2) that the schedule is not readily amenable to statistical control as respects either item values or aggregate premium results, (3) that its application has usually resulted in a net premium deficit, (4) that it discriminates unfairly against small risks and low-rated industries, (5) that the incentives to hazard removal are nullified to some extent by arbitrary credit limits, and (6) that the rate results are affected in an undesigned and erratic fashion by the discrepancy between audited payroll and the payroll stated in the policy declaration.

Several of the foregoing criticisms have been sufficiently enlarged upon by other persons or in other connections. It obviously is impossible, e. g., to determine the premium value of one exposed set screw or one unguarded gear—exposures to injury are neither given nor obtainable in these terms. Obviously, also, it must be very difficult to control the premium results of a schedule whereof the item values are not readily convertible to a common denominator.* Other counts in the general indictment may be less apparent to persons not intimately acquainted with the practical working of the schedule.

It might be argued that an average reduction from manual rates by the application of a schedule is no more than reasonable, provided that the rate reduction reflects an actual improvement in plant conditions. This argument is predicated upon the lag between pure premium experience and manual rates; for any improvement in plant conditions must ultimately find expression in pure premiums. So soon, however, as manual rates are revised upon the basis of this improved experience, schedule credits for the same improvements will result in inadequate premiums.† No schedule, moreover, does, or can, take account of all the multi-

* The Pennsylvania Compensation Rating & Inspection Bureau succeeded in maintaining an approximate balance of debits and credits during 1916 and 1917 by means of detailed statistics of inspection results. For some unexplained reason no other Bureau has attempted to analyze the results of its rating schedule.

† It is alleged, for example, that Massachusetts experience upon paper box making has been greatly improved by the general guarding of corner staying machines, and the manual rate for that State has been reduced in consequence. Obviously a further rate reduction by means of schedule credit from manual rate for the guarding of these same machines would be unwarranted.

tudinous influences which bear upon accident hazard. Improvements in plant and equipment, which are a sufficient ground for rate differences as between individual risks, may be counterbalanced, in the industry as a whole, by concomitant changes in supervision, personnel or rate of work. For these and other reasons underwriters do not look with favor upon a persistent discrepancy between average adjusted rates and pure premium indications.

Granted the need of maintaining a certain rate level, this result can evidently be attained either by periodic revisions of the schedule or by loading the manual rates to offset the expected "merit" reduction—as was actually done for most jurisdictions in the rate revision of 1917.‡ The former method is extremely cumbrous, involving as it does either a change in item values which is likely to disturb such proportion as already exists, or a transference of items from credits to charges, which creates very embarrassing relations between insurer and insured. The method of rate loading would be unobjectionable if all risks in the classifications so treated were actually schedule-rated and if the schedule produced fairly uniform reductions in all classifications. Unfortunately for the hypothesis, neither of these conditions is realized in fact. On the one hand, very small plants (less than $50 annual premium) are not individually rated; on the other hand, the schedule gives average rate increases in certain industries offset by heavy reductions in other classfications. The practical effect of the loading, therefore, is unfairly to burden some employers for the benefit of others.*

The discriminatory effects of the Universal Analytic Schedule are by no means confined to the more or less fortuitous loading already spoken of. It will be seen from the subjoined exhibits, that, as applied in Pennsylvania, the schedule systematically produced an excess of debits upon small risks and low-rated industries, accompanied by an excess of credits upon large risks and high-rated classifications.

‡ See Report of the Augmented Standing Committee on Workmen's Compensation Insurance Rates—1917—Issued by the National Workmen's Compensation Service Bureau.

* The objections to the reverse condition—an excess of schedule debits over credits—are so patent that they need scarce be stated. There is much to be said for a schedule of charges only in the hands of a monopolistic insurer; under competitive conditions, however, such a schedule would be practically unworkable.

TABLE I.

EFFECT OF SCHEDULE RATING IN PENNSYLVANIA, 1917, BY SIZE OF RISK.

Risk Payroll (Annual Basis). 1.	No. of Risks. 2.	Total Payroll. 3.	Weighted Average Rate in Per Cent. of Manual. 4.
ALL RISKS.....	4,761	$199,045,200	98.8%
$ - 5,000.....	249	900,400	109.9%
5,000- 10,000.....	863	6,195,200	110.6%
10,000- 15,000.....	721	8,460,900	107.3%
15,000- 25,000.....	887	16,463,000	105.1%
25,000- 35,000.....	610	17,148,100	103.3%
35,000- 50,000.....	401	16,223,100	101.6%
50,000- 75,000.....	389	22,965,700	100.8%
75,000-100,000.....	206	17,500,500	99.2%
100,000-150,000.....	176	20,367,900	97.8%
150,000-200,000.....	101	16,974,300	95.1%
Over 200,000.....	158	55,846,100	91.5%

TABLE II.

EFFECT OF SCHEDULE RATING IN PENNSYLVANIA, 1917, BY MANUAL RATE.

Manual Rate. 1.	No. of Risks. 2.	Total Payroll. 3.	Weighted Average Rate in Per Cent. of Manual. 4.
ALL RISKS.....	4,761	$199,045,200	98.8%
$ .15- .20.....	317	21,970,600	104.2%
.20- .26.....	345	22,365,500	104.1%
.26- .45.....	410	22,435,000	104.2%
.45- .60.....	743	35,507,300	100.8%
.60- .90.....	769	30,174,200	100.2%
.90-1.20.....	970	28,573,800	98.8%
1.20-1.50.....	601	19,479,000	97.1%
1.50-2.00.....	411	11,809,800	98.1%
2.00-3.50.....	156	5,564,200	94.7%
Over 3.50.....	39	1,165,800	88.3%

These results are corroborated by experience with variants of the same schedule in other states.* They are, in fact, inherent in the structure of the schedule. Most of the charges are flat amounts, whereas most of the credits bear a direct ratio to manual rate. Hence of two plants having the same payroll and developing the same item charges and credits, that which belongs to a low-rated classification will receive a net premium increase, and that which belongs to a high-rated classification will obtain a net premium decrease.† The flat charges, of course, are based upon the assump-

* See * on page 330.

† Applied to a hosiery establishment (Pennsylvania rate $.30) with a payroll of $100,000, flat charges of $90 and rate credits of 10 per cent. will produce a net premium *charge* of 20 per cent. Applied to a can factory

tion that the hazards reflected by them are independent of manual rates.* But the total hazard of the industry is necessarily reflected by the pure premium from which the manual rate is derived; an average rate increase by the operation of the schedule implies an average degree of hazard not indicated by experience. The injustice done to small employers is less clear: no analysis has ever been made, so far as the writer is aware, to show whether the experience of small risks is better or worse upon the whole than the experience of large risks. Small plants will doubtless average worse in respect of physical conditions, perhaps also with respect to supervision, than large establishments. Apart from such considerations, however, the small plant will usually have more machines, more elevators, more stairways and more floor space in proportion to payroll than large plants in the same industry. The flat charges, accordingly, produce a greater rate increase in a small than in a large establishment with the same ratio of defective to total equipment and with the same relative exposure to hazard.†

If the flat charges thus tend to excessive premiums upon small and low-rated establishments, the flat machine credits produce anomalous and sometimes excessive rate reductions. The machine points of operation credits, e. g., may have the curious result that more credit is given for the guarding of a dangerous machine than for its absence. These points of operation credits, moreover, being independent of rate, are a higher proportion of total premium in low-benefit than in high-benefit jurisdictions—a result not justified by any theory of rate-making. Further, wherever the number of working machines exceeds the number of employees, the machine credits may become excessive. To meet this contingency an arbitrary stop limit of ten per cent. of rate was established, whereby it

(Pennsylvania rate $1.50) with the same payroll, the same flat charges and the same rate credits give a net premium *credit* of 4 per cent.

* Cf. Hansen, *Proceedings*, Vol. I, p. 222; Whitney, *ib.*, p. 254.

† Mr. Hansen (*loc. cit.*) argues (1) that the exposure to the flat-charge defects is constant, irrespective of the number of employees and (2) that fixed charges are necessary to secure the correction of these defects. But it is not true that the exposure to, say, a flight of stairs is the same in a ten-man plant as in a hundred-man plant. The excessive ratio of exposure points to payroll in small establishments is mainly due to the presence of equipment which is only partially utilized and does not represent a greater proportionate exposure thereto. As to the second consideration, a rating schedule must first of all produce an equitable distribution of premiums.

comes to pass that the maximum allowable credit may be obtained by safeguarding a part only of the mechanical equipment.

The flat values, lastly, are not in practice—what the theory requires—fixed premium amounts. In applying the schedule all items are finally converted into a rate, which rate, as respects the flat values, necessarily depends upon the payroll disclosed by the policy declaration.* If, therefore, as ordinarily happens, the payroll is materially understated, the adjusted rate is either higher or lower than the schedule-makers intended, according as flat charge or credit items preponderate in the individual case.† It is not

Declaration Payroll. 1.	Man. Rate. 2.	Rate Credits. 3.	Prem. Charges. 4.	Prem. Credits. 5.	Adj. Rate. 6.	Audited Payroll. 7.	Adjusted Premium. 8.	True Adj. Rate. 9.	True Adj. Prem. 10.
$100,000	$1.00	10%	$300	$100	$1.10	$200,000	$2,200	$1.00	$2,000
100,000	1.00	10	100	300	.70	200,000	1,400	.80	1,600
200,000	1.00	5	400	200	1.05	100,000	1,050	1.15	1,500

simply that the flat values themselves fluctuate by as much as one hundred per cent. from a mere difference in payroll estimate; the total rate upon the risk varies within wide limits from the same fortuitous occurrence. The occurrence is not even always fortuitous; brokers are shrewd enough to manipulate payroll estimates with an express view to schedule rating results.

II.

The National Reference Committee on Schedule Rating,‡ in the work of revision lately completed, undertook to correct ad-

* In the 1916 Pennsylvania Schedule an attempt was made to treat the flat charges as net premium additions, over and above the rate expressed in the policy. This practice would have realized the theory of the flat items—only the flat premium additions proved uncollectible in practice.

† This is concretely shown in the exhibit below. In the first case, owing to preponderance of flat charges, the employer is penalized $200 in his final premium for underestimate of payroll. In the second case, by following the same all but universal practice, the employer secures an unmerited reduction of 10 per cent. of his final premium. In the third case, by a lucky overstatement of payroll, the employer saves 10 per cent. in his final premium adjustment. Otherwise stated, in the first case the nominal flat charge of $300 has been raised to $600; in the third case $200 has been collected in lieu of a nominal premium charge of $400.

‡ Formerly the Standing Committee on Schedule Rating.

mitted defects of the Universal Analytic Schedule without sacrificing its valuable features. The result of their labors is known as the Industrial Compensation Rating Schedule, 1918.*

The standards of safeguarding were thoroughly overhauled with a view to conforming more closely with the best engineering practice and with the legal standards of the several states. These latter were found to differ widely among themselves so that it was necessary to enlist the co-operation of state and federal authorities in the task of reconciling statutory and administrative requirements. By dint of many conferences and subcommittees, substantial uniformity was secured with the official standards of New York, New Jersey, Pennsylvania, Wisconsin and the United States Government, as also with the standards of the National Safety Council and the American Society of Mechanical Engineers. The Industrial Compensation Rating Schedule, 1918, much more than any of its predecessors, may thus claim to embody universal safety standards. This highly gratifying result was, of course, made possible by the antecedent labors of schedule-makers during a period of years.

2. Inasmuch as the flat premium values of the Universal Analytic Schedule had proven especially unsatisfactory in practice, the Committee wholly abandoned this method of value expression. All items in the 1918 Schedule are valued either in per cent. of manual rate or in cents on payroll. In this way a schedule rate is produced which does not in any manner depend upon or vary with the estimated payroll disclosed by the policy declaration. Since, moreover, all compensation insurance rates are quoted in per cent. of payroll, the item values of the 1918 Schedule are, as respects any given risk or any given classification, not merely reducible, but already reduced to a common denominator.

3. The awkwardness of the Universal Analytic Schedule with respect to rate control was overcome by the device of rating formulae. Thus the charge for elevator defects is applied by the formula:

* The work of formal revision was begun in October, 1917, and was finally ratified by the Joint Conference of the Schedule Rating Committees of the National Workmen's Compensation Service Bureau, the Compensation Inspection Rating Board (New York), the Massachusetts Rating and Inspection Bureau, the Compensation Rating and Inspection Bureau of New Jersey, and the Pennsylvania Compensation Rating and Inspection Bureau, March 26, 1918.

$$\left(\frac{D}{E}\right) K = \text{Rate charge per \$100 of payroll,}$$

in which D represents the number of elevator defects in the particular risk, E the number of plant employees, and K the rate value assigned to elevator hazards. Obviously, the premium results of this formula can be modified to any desired degree by modifying the factor K without altering the relative weight of the several elevator items or changing any item from a charge to a credit. So also with the credits for general machine guarding, for guarded machine points of operation, and for motor drive and the charge for unguarded transmission: in each case the premium results can be controlled by a single constant in the rating formula. This high degree of flexibility in the schedule as a whole and in its several component items constitutes a distinct advance in schedule making.

4. Still more fundamental and far reaching is the committee's attempt to relate the item values of the schedule to accident cost. Every rating schedule purports to establish rates of individual risks which shall be proportionate to certain enumerated hazards thereof.

In Professor A. W. Whitney's expressive phrase, schedule rating is a refinement of classification rates by way of rate increases or decreases for the presence or absence of specified hazard characteristics which serve to differentiate the risk in question from others in the same manual classification. To this end a definite rate or premium value is assigned to each risk feature whereof the schedule takes account. If, and insofar as, the values so assigned do not correspond to probable loss cost the ostensible purpose of the schedule, as respects rate adjustment, is defeated. Scientific schedule-making, accordingly, must depend upon the statistical determination of partial pure premiums answering to the specific hazards—in the case of compensation insurance, the specific accident causes—covered by the schedule.

Unfortunately, neither insurance carriers nor state administrative bodies have thus far compiled accident statistics in the requisite form and volume. The insurance carriers, indeed, have heretofore made no analysis of their loss experience by cause of accident. The state statistics hitherto published, though covering a considerable exposure, have suffered from incompleteness of the data and from want of uniformity in cause classification.* Some guidance

* The Committee on Statistics of the International Association of Indus-

as to the relative importance of certain great groups of accident causes—working machines, machine points of operation, power transmission, elevators, cranes, stairways, balconies—was obtained from the published reports of Wisconsin, Massachusetts and Ohio. For the most part, however, the correlation of item values with pure premiums must await the development of suitable accident statistics.

Appreciating the inadequacy of present data, the committee nevertheless deemed it worth while both to make use of such statistical information as could be obtained and to throw the schedule into such form as to admit of ready comparison between item values and accident cost. The items of the 1918 Schedule are arranged in three broad groups corresponding, respectively, to structural hazards, mechanical hazards, and plant morale. The term "structural" is used in a broad sense to include buildings and such relatively fixed equipment as boilers, elevators, cranes and electric installation.* "Mechanical" is more narrowly defined as referring to the hazard of power machines and the driving mechanism appurtenant thereto. The actual sequence of items is mainly governed by considerations of convenience to inspectors and employers. Logically, the several catastrophe hazards, e. g., might well be brought together. For field use, on the contrary, it is more advantageous to group all items relating to buildings, all those relating to boilers, and so on. With few exceptions, however, it will be found that each item corresponds to a recognized subdivision in the standard classification of accident causes.

trial Accident Boards and Commissions have formulated a series of standard classifications which have been adopted for prospective use by New York, Massachusetts, Ohio, Wisconsin, Ontario and the United States Employees Compensation Commission. See Bulletin 201 of the United States Bureau of Labor Statistics and the *Monthly Review* of the same Bureau for October, 1917.

Essentially the same classifications have been adopted by the National Workmen's Compensation Service Bureau.

*The "structural" section—Items 100 to 231 inclusive—is admittedly somewhat hodge-podge. Fire exits, stairs, balconies, floors and floor openings are indubitably structural. Elevators and cranes may likewise be regarded as integral parts of the building, though possessing also a mechanical aspect. But it is a straining of language to apply the term to boilers, electric generators or an acid distributing system.

Structural Items.

The catastrophe items* are valued at a uniform rate per $100 of payroll, irrespective of industry classification, as was the case also in the Universal Analytic Schedule. The same treatment is applied to high voltage electricity and to acid distributing systems. The justification of this procedure is that the item values are small, that the variations therein from industry to industry are unimportant relatively to total rate, and that all employees in a given establishment are or may be exposed to the hazards in question.

The case is otherwise with respect to the non-catastrophe structural items. These features of plant construction and equipment —balconies, platforms and trestles, floors and floor openings, stairs, elevators, cranes—bulk large in point of accident cost, their importance relatively to total rate varies markedly from industry to industry and the hazards arising therefrom commonly affect a part only of the employees of a given establishment. The corresponding item values, accordingly, are not a simple function of either payroll or manual premium. These hazards, in fact, are nearly proportionate to the number of danger points per hundred employees. The differences between industries already spoken of are rather in the average exposure per danger point than in the magnitude of the individual hazards themselves. Given the same number of employees, an unrailed stair, an unguarded elevator entrance or a hole in the floor presents practically the same risk of injury in a silk factory as in a carpenter shop. Logically, therefore, risk deviations in respect to these hazards should be measured by the formula:

$$(1) \qquad \left(\frac{U-N}{N}\right) K = \text{cents on payroll,}\dagger$$

* Item 111, fire exits; 112, fire-fighting appliances; 203, boiler-room exits; 206, absence of boilers; 207, boiler inspection; 221 and 222, explosive vapors; 302, engine governors. Item 101, first floor occupancy, relates only in part to catastrophe. The schedule thus far has not attempted to deal with the serious catastrophe hazards of particular industries.

† This formula was suggested by Mr. R. M. Pennock, of the State Workmen's Insurance Fund of Pennsylvania. K might, of course, be written as a per cent. of manual rate, differing for each industry. But this would merely introduce two variables in the rating of each item. Since the hazard to be measured bears no derivative relationship to, and is not affected by, the specific hazard of the industry, it seems more advantageous to express K as a constant per $100 of payroll.

Cranes doubtfully belong in this group. It seems probable that the crane hazard bears a fairly close relationship to the materials, processes and products which characterize the specific industry.

where K is the rate value of the item, irrespective of the industry, U is the number of danger points per hundred employees in the individual risk and N the standard or normal number of such danger points per hundred employees for the industry classification. This formula, evidently, will give credits as well as charges, according as $(U-N)$ is negative or positive.

In practice, the importance of these items has not been deemed to warrant so much refinement in rating methods. The N values in the above formula would evidently vary both from industry to industry and from state to state; the ultimate statistical groups, therefore, are likely to be too small to give dependable averages. The use of many different values, moreover, would greatly enhance the clerical labor of rating. For practical purposes, it probably is sufficiently accurate to use average N values derived from schedule-rated industries as a whole. This simplification at once eliminates credits for less than average exposure—no one would wish, e. g., to credit a watch factory for the absence of locomotive cranes or even for the absence of defective flooring—and confines the structural items to charges for defective or substandard conditions as defined by the schedule. Thus simplified, the rating formula runs:

$$\left(\frac{D}{E}\right)KN = \text{cents on payroll}, \tag{2}$$

where K is the item rate value as before, D is the number of defect points in the individual risk, E the number of plant employees, and N the normal or standard number of employees per defect point in schedule-rated industries. Further simplification (in point of office procedure) can evidently be secured by means of weighted defect points such that D combines the frequency of occurrence (N value) with the rate value of the item, and K becomes uniform for all structural items.* This is the method adopted by the committee, giving the formula:

* Thus, if the rate value of the elevator-gate hazard be taken at \$.01 and the frequency of unguarded elevator entrances at two per hundred employees, one unguarded entrance in a twenty-five-man plant would be rated by formula (2):

$$(\tfrac{1}{25})(\tfrac{2}{1})(\$.01) = \$.02 \text{ on payroll.}$$

The same result, evidently, is attained by formula (3) with a K value of \$.125 and a weight of four points per elevator gate. Thus:

$$(\tfrac{4}{25})\ \$.125 = \$.02 \text{ on payroll.}$$

$$(3) \qquad \left(\frac{D}{E}\right)K = \text{cents on payroll,}^*$$

wherein E is the number of plant employees, D the number of defect points multiplied by the item weight of each and K is a constant per unit of payroll. The K value should, of course, be modified by the law differential of each state.

The committee formula, it will have been observed, gives a practically constant premium value per defect. Insofar, the flat values of the Universal Analytic Schedule appear to be confirmed by the latest attempt at schedule building. Indeed, pending the statistical determination of D, the actual judgment values of the former schedule were retained. The advantages of the formula are: independence of payroll estimates in the rating of risks, facility of rate control, and the ability to relate the item values to normal exposures and pure premium values so soon as these shall have been statistically determined.

Mechanical Items.

The mechanical hazards† stand in marked contrast with the structural in that they bear in general a close relationship to the total hazard of manufacturing industry. Not only does machinery far outweigh any other single group of accident causes in most branches of manufacturing;‡ the kind and amount of mechanical

* The number of employees is taken at a minimum of twenty-five which has the intended effect of reducing the premium value per defect upon very small plants.

K, at present, is uniform for all states. The committee recognized that the value should be proportional to the scale of compensation benefits, but felt that this refinement could well wait until the D values themselves are statistically determined.

† The mechanical hazards fall into three broad groups: power transmission, from the prime mover to the individual machine; machine hazards other than points of operation, being machine drives and sundry moving parts; and machine points of operation. The point of operation is the machine "tool" as distinguished from the mechanism of power transmission and control; that which acts directly upon the material and performs the cutting, shaping, pressing or forming action of the machine. The point of operation may be hazardous or non-hazardous. Circular saws and hand-fed stamping presses stand at one end of the hazard scale; at the other may be placed an automatic screw machine or a watchmaker's lathe.

‡ Foundries, blast furnaces, breweries and glass works—to bracket industries which have little else in common—are notable exceptions.

equipment, which go to determine the extent of mechanical hazard, are highly characteristic of each specific industry, being in fact closely dependent upon the materials worked with and the products turned out. For the same reason, the proportion of machine to total hazard varies pretty directly with the number of machines per hundred employees.

These considerations point to the rating formula:

$$(4) \quad \left(\frac{U-N}{N}\right) R = \text{per cent. deviation from manual rate,}$$

where U is the number of machine danger points per hundred plant employees in the particular risk, N the normal number of such danger points per hundred workmen in the industry class, and R the proportion of pure premium attributable to mechanical hazards. R and N will, of course, vary from industry to industry, while U will vary from plant to plant. In arriving at the values of U and N account should be taken of guarded as well as unguarded equipment; the best guarding removes the hazard of machinery only in part. For the purpose in hand it would perhaps be reasonable to take each guarded unit at a weight of one point and each unguarded unit at a weight of two points. The advantage of this method is that it allows for the wide differences in ratio of machine exposure which are actually encountered within the same industry. One hundred machines per hundred employees, all fully guarded, may well represent a greater hazard than forty similar machines per hundred workmen, though all unguarded. The formula above suggested takes account of both factors—the ratio of machine equipment to employees and the extent of guarding. It will, therefore, produce what has not hitherto been accomplished: a rate deviation proportionate to the hazard deviation from the classification norm.*

To apply this formula it would be needful to know with a fair degree of accuracy, for each classification, the average ratios of guarded and of unguarded machinery to employees and the ratio of machine accident cost to total pure premium. This information is at present unobtainable. What is known is the total number of machines per hundred employees for each of the principal schedule-

* For a fuller development of this point see *Proceedings*, Vol. III, pp. 38–39.

rated industries and a rough approximation to the proportion of machine accident cost for schedule-rated industries as a whole. Having in mind the limited information available, as also the difficulty of making a violent break with past practice,* the National Reference Committee adopted (for general machine guarding) the simplified formula:

$$(5) \qquad \left(\frac{G}{M}\right) RN = \text{Credit in per cent. of manual rate,}$$

wherein M is the number of machines in the particular plant, G the number of guarded machines, N the classification ratio of machines to employees, and R a uniform percentage of manual rate. With an R value of ten per cent., the allowable credit becomes fifteen per cent. where (as in cotton spinning) N is 1.5, and one and one-half per cent. where (as in blast furnaces) N is .15. The use of RN in lieu of a varying R is grounded on the hypothesis—for which there is both *a priori* and statistical warrant—that the proportion of machine to total hazard varies with the number of machines per hundred employees. It is, of course, a convenience in office rating. The weakness of the committee formula is that it ignores risk deviations from the classification machine ratio. An establishment with less than normal machine exposure is credited only in the sense of having to guard fewer machines to earn the same rate credit.† Transmission apparatus is treated in the same fashion except that here RN expresses a charge for unguarded equipment or a credit for direct motor drive. In this connection the assumption was made that the transmission exposure of a given industry bears a direct ratio to the machine exposure. Machine points of operation, lastly, are rated for credit in the same way, but with a different set of $N(n')$ values. For there are many

* In the past, *unguarded* transmission has been *charged,* motor drive, *guarded* machines and *guarded* points of operation have been credited. These distinctions may or may not be well founded; the point is that a change from charge to credit may seriously affect premium income whereas the opposite change will certainly create serious friction with the insuring public.

† Given a payroll of $80,000 and a manual premium of $1,200, a carpenter shop which has 100 machines would receive a premium credit of $1.20 per guarded machine. Another shop, with the same payroll and the same manual premium, but with only 40 machines, would receive a credit of $3.00 per guarded machine. This difference in premium credit is intended.

machines which have no point of operation hazard, so that no constant relation will hold between the classification ratio of machines to workmen and the like ratio of machine points of operation.* It is to be observed that the schedule treats transmission apparatus as normally guarded and charges for the unguarded units, whereas it considers machines and machine points of operation as normally unguarded and credits the guarded units.

Morale Items.

The moral items—safety organization, first-aid and hospital facilities, light, ventilation, general orderliness—relate to safety measures or practices which affect all employees in the given establishment and which have a preventive value directly proportionate to the total hazard of the industry. Very properly, therefore, these item values are expressed immediately in per cent. of manual rate.†

The writer has elswhere argued‡ that the effectiveness of those safety measures which are here in question can best be gauged by the accident experience of the plant. The factors affecting safety morale, as distinguished from physical safeguards, are legion and for the most part intangible. For the purposes of schedule rating it is necessary to judge plant morale by certain external criteria—the amount of litter in the aisles, the nurse's certificate of competency or the records of safety meetings. In the nature of the case, no definite standards can be set up which go to the root of the matter: the spirit in which supervision, discipline, education and accident treatment are administered. At the same time, it is not possible to relate the morale item values in any definite way to fractional pure premiums. Safety supervision, or the want of it, is not a specific cause of accidents; it operates by affecting for good or ill every specific source of danger. On these grounds it would seem preferable to confine the schedule to physical features of

* For flour mills the N value is 1.5 and N' .05, for planing mills, N is 1.0 and N' .9, for can manufacturing, N is .6 and N' .5.

† This justification will not hold for the per cent. of rate values assigned to such personal safeguards as respirators, eye protectors and foot and leg protectors. These safeguards do not affect the entire payroll of any establishment and the specific hazards—flying fragments in grinding or chipping, irrespirable dust or fumes, molten metal—which they are intended to counteract do not vary with the total hazard of the industry.

‡ *Proceedings*, Vol. III, p. 40.

plant and equipment and to measure morale, insofar as it is capable of measurement, by experience rating. The schedule rate would thus become a prediction of certain accident costs based upon the characteristics of the industry and the apparent hazards of the establishment. Experience rating would check up this prediction in the light of the establishment record. Insofar as the classification rate and the schedule values are correct, experience deviation from schedule-classification rate would indicate deviation from average morale.

It is questionable, however, whether the time is ripe for so drastic a step. Experience rating has yet to approve itself in practice as a fair measure of risk deviation from classification hazard. The schedule values have yet to be placed upon a sound statistical basis. Meanwhile, safety engineering and medical opinion asserts with great unanimity that certain positive measures—safety organization and education, first-aid treatment of wounds, appropriate eye, lung and foot protection against well-defined occupational hazards—have a high degree of efficacy in reducing the number and severity of accidental injuries. It probably is well worth while, therefore, for the present, to subordinate accuracy of rating in this particular to accident prevention and to hold out definite inducements in the schedule for the adoption of these measures. Reasoning thus, the committee retained the morale items with purely judgment values. With respect to the most important of these items, however, and the item which is most difficult to gauge by external criteria—safety organization—the extent of credit is made to depend upon the accident record of the risk.*

* It is possible to meet all the external tests that can practically be set up for safety organizations at relatively small expense and without achieving useful preventive results. The large credit in the Universal Analytic Schedule—ten per cent. of manual rate—consequently called into existence many "paper organizations," which went through the prescribed motions but exerted no perceptible influence on accident occurrence.

The National Reference Committee proposed to test the effectiveness of safety organizations by accident time loss computed in such a way that temporary accidents would count for full time loss and fatal and permanent injuries for a low arbitrary value. Purely from considerations of administrative convenience, the "all other" accident cost of the experience rating plan recently adopted by the National Reference Committee on Workmen's Compensation Insurance was substituted for this test.

III.

Two or three general observations upon the theory of schedule rating which underlies the foregoing discussion will bring this paper to a close.

1. Every plan of individual risk rating presupposes a classification rate to which the individual rating is applied by way of modification. On the one hand, with extremely few exceptions, the exposure of an individual insured risk is wholly insufficient to develop a stable experience. On the other hand, no rating schedule can take account of all the component hazards of industry or can accurately measure even those with which it attempts to deal. In any sound system of rate-making, therefore, the classification rate must remain the principal and controlling element in the rate of individual risks. The function of individual risk rating, whether by experience or schedule, is to establish risk deviations from the classification average.

Starting from this principle, the risk deviation in respect to any given hazard, as machines or elevator gates, would be expressed by the formula:

$$(6)\quad X=\left(\frac{U-N}{N}\right)r \quad \text{or} \qquad (7)\quad Y=\left(\frac{U-N}{N}\right)k,^{*}$$

wherein X is the item charge or credit in per cent. of manual rate, Y the item charge or credit per unit of payroll irrespective of manual rate, r the proportion of classification rate attributable to the hazard-group in question, k the absolute rate value of the item, N the number of danger points of the specified kind per unit of exposure in the industry classification at large, and U the number of such danger points per exposure unit in the individual risk. As between r and k, X and Y, preference should be given to value expression in terms of manual rate, because it is the manual rate in which the classification experience is summed up, and to which individual risk rates are to be related. Since the component hazards of industry are not in general cumulative—the elevator hazard does not affect the crane hazard nor does the crane hazard multiply the hazard of machines—the several items of the schedule may be taken additively. The risk deviation, in other words, is obtained by

* These formulae take no account of catastrophe hazards, which for most manufacturing industries are all but negligible.

adding the several X's and Y's to the classification rate. The general formula would thus be:

$$(8) \quad I = R + (Y_1 + Y_2 \cdots + Y_n) + (X_1 + X_2 \cdots + X_n),$$

I being the risk rate and R the classification rate. In practice, X would, of course, be reduced to cents on payroll by applying the given percentage to the classification rate.*

This general formula, if constructed and revised upon an adequate statistical basis, will automatically produce a balance of aggregate premium charges and credits, because it will produce such a balance upon each schedule item, since it lies in the nature of weighted averages that the total deviation is equal in both directions. A balance may, of course, be obtained in other ways: by the awkward revision of item values and the equally awkward interchange between credit and debit columns heretofore in use, by loading the manual rates to compensate for schedule decreases, or by applying a schedule of charges only to such percentage of manual rate as will serve to produce the desired premium income.† But, apart from other disadvantages, no one of these methods gives the true risk deviation from the classification rate with respect either to the schedule as a whole or to the schedule items severally.

The assignment of particular items to the credit column and of others to the debit column, as heretofore practised, is mainly arbitrary; the decision in any given case turns rather upon rate effect than upon any statistical determination of facts.‡ Even if it be true, as it doubtless is, that a majority of elevator entrances are guarded and a majority of machine belts unguarded, still the normal and prevalent condition, in both instances, is a certain proportion of guarded and a certain proportion of unguarded equipment. To make the one item wholly a matter of charge and the other wholly a matter of credit is to penalize or reward employers for

* Purely for illustration, assume a carpenter shop for which R is \$1.50, Y_1 (floors) is + \$.01, Y_2 (floor openings) is + \$.03, Y_3 (stairs) is + \$.035, Y_4 (elevators) is + \$.05, X_1 (transmission) is + 10 per cent., X_2 (general machine hazard) is — 20 per cent., and X_3 (machine points of operation) is — 5 per cent. I is then \$1.40.

† This last is the method adopted in the Coal Mine Compensation Rating Schedule of Pennsylvania.

‡ This is particularly notable in the forced and arbitrary definition of transmission equipment—Industrial Compensation Rating Schedule, 1918, Item 320 and 329(3).

conditions which are in part contemplated in the manual rate. This effect is especially marked in the case of items with respect to which it is difficult to say whether guarding or failure to guard is prevalent. Under the rating method above described, these difficulties disappear. Each item carries a charge or credit according as the risk hazard with respect thereto is greater or less than the average of its class.*

2. For the development of a rating schedule upon the lines here indicated, it is necessary to obtain statistics of plant equipment and statistics of pure premiums by cause of accident.

The requisite information under the first of these heads can be secured from schedule-rating inspections. Most of it, indeed, is already available upon existing inspection reports. Tabulation of these reports by the several rating bureaus† will readily develop the item norms. For the most important items, these norms should be known by industry "groups"; for other items it will be sufficient to establish norms for industry "schedules."‡ The norms will, of course, change—it is to be hoped, for the better—from year to year; to some extent, also, they will vary from state to state. Inasmuch, however, as schedule-rated plants are inspected annually, the information can always be kept well abreast of the latest pure premium developments.

* One serious practical difficulty is glossed over in the text—the difficulty, namely, of obtaining accurate employee exposures. It is, fortunately, not necessary, for the purpose in hand, to obtain exposures in terms of man years. In a given plant which has a given number of machines, belts, elevators, floor openings and what not, and employs a given number of workmen, the exposure per employee hour and per payroll unit is the same whatever the number of hours worked per day, week or year. What is needed, is the average number employed when the plant is in operation. Since this number fluctuates from day to day and from season to season—even from shift to shift—an actual count at the time of inspection may give results as erratic as the payroll estimates on policy declarations. It should be possible, however, to ascertain the approximate average from plant records taken at monthly or quarterly intervals.

† The Pennsylvania Compensation Rating and Inspection Bureau is already making this tabulation. Similar tabulation by all bureaus has been requested by the National Reference Committee on Schedule Rating.

‡ The terms "groups" and "schedules" are here used in the sense defined by the Statistical Committee of the International Association of Industrial Accident Boards and Commissions (Bulletin 201 of the United States Bureau of Labor Statistics) and by the "Code Manual" of the National Workmen's Compensation Service Bureau.

The ascertainment of fractional pure premiums corresponding to specific accident causes should not prove extremely difficult. It is understood, indeed, that most insurance carriers already have this information on punch cards. The precise bearing of the information when obtained may call for some further remark. Given that machine points of operation are responsible for one-fourth of total accident cost in the planing-mill group of industries, and that the normal exposure in this industry group is thirty guarded and sixty unguarded points of operation per hundred employees, what credit should be allowed for guarding one buzz planer in a hundred-man mill? Stated in these terms the problem appears at first blush insoluble. It is not possible to ascertain either the total number of machines which produced the pure premium in question nor the number of employees exposed thereto; in these directions the data will carry us no further than bare ratios. Still less is it practicable by mass statistics to determine the relative hazard of guarded and unguarded buzz planers or of buzz planers and buzz saws, individually considered. But because a perfectly accurate solution is unobtainable it is not necessary to reject every approximation. Knowledge, in practical affairs, always requires to be supplemented by that species of inference which is termed judgment; yet judgment is the surer the more full and exact the knowledge upon which it operates. The main use of statistics, indeed, is to limit the area and guide the direction of practical judgment.

In the instant case, there is abundant evidence from plant records that the cylindrical-head jointer is safer than the square-head type, that certain saw guards, feed roll guards and planer guards do reduce the number and severity of accidents, and that woodworking by power machinery is more hazardous than woodworking by hand somewhat in proportion to the machine employee ratio. It is no very violent assumption from the facts known that the guarding to standard of woodworking machines would reduce the point of operation hazard by one-half. On this assumption, the guarding of one point of operation in a hundred-man planing mill would be worth $\frac{1}{6}$ per cent. of manual rate and the complete elimination of one point of operation would deserve a credit of $\frac{1}{3}$ per cent. of manual rate.* These values will hold so long as the item norm and the corresponding fractional pure premium are

* Formula (6), counting each guarded machine as one and each unguarded machine as two. On the facts assumed, r is 25 per cent. and N is 150.

derived from the same experience. For the pure premium reflects the hazard of the total equipment as it existed at the time: divergence of the individual risk from the conditions reflected in this pure premium will warrant a proportional departure from the manual rate predicated thereupon.

3. The method of rating by means of deviations from item norms will, to a great extent, obviate the necessity of building separate schedules for different manufacturing industries. The same general accident causes are common to most branches of manufacturing; differentiation occurs, not so much in the presence or absence of specific causes, as in the intensity of hazard and the relative importance of the several cause groups. The same schedule items, accordingly, with appropriate variations of item norms and item values, are applicable to a wide range of industrial conditions. Certain items of little general importance may require to be inserted for specific industries; it may even be necessary to develop a separate schedule for such an industry as explosive manufacturing, the chief hazards of which are peculiar to itself. It should be possible, however, by a mere extension of methods already adopted,* to apply the same general schedule with a fair degree of equity to the great majority of manufacturing enterprises.

If the foregoing conclusions are at all correct, the Industrial Compensation Rating Schedule, 1918, constitutes an important advance upon its predecessors. It is more elastic in respect of adaptability to varying industrial conditions, more flexible in respect of statistical control, more organic in structure, more in accord with the theoretic requirements of individual risk rating. The standards have been improved in many points of detail, anomalies of the former schedule, as applied especially to small risks and low-rated industries, have been corrected; above all, it is believed that a foundation has been laid for future development. The erection of a sound and stable superstructure will mainly depend upon the accumulation and analysis of appropriate statistical data.

* In the 1918 Schedule, each classification carries specific N and N' values (normal ratios of machines and machine points of operation to employees). In addition, a number of items are restricted to specifically designated classifications.—See "List of Classifications Subject to Schedule Rating."

LEGAL NOTES.

BY

RICHARD FONDILLER.

(OF THE NEW YORK BAR.)

ACCIDENT AND HEALTH.

CONSTRUCTION OF "ACCIDENTAL MEANS":—(Salinger *vs.* Fidelity & Casualty Co., Court of Appeals of Kentucky, 198 S. W. Rep. 1163.) The plaintiff had an accident policy which insured him "against bodily injury sustained . . . through accidental means . . . and resulting directly, independently and exclusively of all other causes" during total or partial disability. While lifting goods, he discovered that he had lost the sight of one eye and sued the defendant company for the indemnity fixed in the policy for this loss. The undisputed medical testimony on both sides showed that owing to the plaintiff's general physical condition he had a floating clot in the eye, which was the direct cause of the blindness.

The court handed down its decision for the defendant, quoting the following from 182 S. W. 252:

"The general rule is that an injury is not produced by accidental means, within the meaning of this policy, where the injury is the natural result of an act or acts in which the insured intentionally engages. A person may do certain acts the result of which produces unforeseen consequences resulting in what is termed an accident; yet, it does not come within the terms of this contract. The policy does not insure against an injury that may be caused by a voluntary, natural, ordinary movement, executed exactly as was intended. Therefore, to determine the matter, we look, not to the result merely, but to the means producing the result. It is not sufficient that the injury be unusual and unexpected, but the cause itself must have been unexpected and accidental."

WAIVER OF NOTICE OF ACCIDENT:—(Sweeney *vs.* Travelers Ins. Co., Supreme Court of Michigan, 165 N. W. Rep. 775.) The plaintiff was insured by the defendant company under an accident policy, which contained the following clause:

"Immediate written notice, with full particulars and full name and address of insured, is to be given said company at Hartford, of any accident and injury for which claim is made. Unless affirmative proof of death, loss of limb or sight, or duration of disability, and of their being the approximate result of external, violent, and accidental means, is so furnished within seven months from the time of such accident, all claims based thereon shall be forfeited to the company. . . . No agent has power to waive any condition of this policy."

The insured met with an accident, and did not give notice to the company until over seven months later. The company unsuccessfully attempted to adjust the claim, through its agent, who in correspondence and personally stated that negotiations were being carried on without prejudice to its rights under the policy. The court gave judgment for the defendant, upon the ground that notice of accident was filed too late, and that no act or negotiations of the agent could be construed as a waiver because the policy expressly provided that no agent had power to waive any condition.

SUICIDE—MATERIAL REPRESENTATIONS:—(Olsson *vs.* Midland Ins. Co., Supreme Court of Minnesota, 165 N. W. Rep. 474.) Olsson was insured under a health and accident policy, which was in force when he died from a gunshot wound. His wife, the beneficiary of the policy, was the plaintiff in this suit. The defense was that the insured had knowingly made material misrepresentations in his application, which nullified the liability under the policy in (1) stating that he had never had hernia or fits, (2) stating that he had not received medical or surgical attention within five years. Another defense was that the insured had committed suicide.

In giving judgment for the plaintiff, the court disposed of these defenses in the following extracts from the opinion.

"The only testimony as to what occurred was that of the local manager [of the company], and he was interested. From all the circumstances the jury were justified in believing that the statements were passed over lightly by the manager, that they were met by a general statement on the part of Olsson that he was all right or that nothing was the matter with him, without an appreciation of their real significance, and that with such general statement the defendant chose at the time to be satisfied. In making out the application the manager was the agent of the company and not of the insured.

"A copy of the application was attached to the policy as required by statute and was delivered to the insured. This fact, while a circumstance to be considered in determining whether the insured knew the statements made in the application, does not alone and as a matter of law charge him with them. Whatever the rule is elsewhere, we do not understand that in this state the mere retention of the policy to which a copy of the application is attached, with no other circumstance affecting the result, estops the insured or his beneficiary as a matter of law from asserting that the statements contained in it were not his representations.

"There is no suicide provision in the policy. In the case of an ordinary life policy, payable to a beneficiary, without a provision as to the effect of suicide, the law of this state permits a recovery even in the event of suicide when sane. We assume, without deciding, that this rule does not apply to an accident policy. The rule is universal, in any event, that a suicide when insane does not prevent recovery unless expressly so provided in the policy."

DEATH BY SUBMARINE:—(Woods *vs.* Standard Accident Ins. Co., Supreme Court of Wisconsin, 166 N. W. Rep. 20.) The insured held an accident policy which contained the following clauses:

"The company hereby insures the individual who purchases this ticket in person against the effects of bodily injuries received during the term of this insurance and affected solely by external, violent, and accidental means, subject to all the conditions and limitations hereinafter contained.

"This ticket is issued by the company and accepted by the insured with the understanding and agreement that no benefits will be paid for injuries, resulting fatally or otherwise, received under or in consequence of any of the following conditions: . . . (3) While engaged in aerial navigation, hunting, fishing, or on exploring expeditions, or under any circumstances from firearms of any kind or from explosives; or (4) from wrestling, lifting, racing of competitive games, or when inflicted upon the insured by himself or any other person, or received by the insured while insane, or inflicted by the insured upon himself while insane."

He was a passenger upon a steamer which was sunk by a submarine near the coast of Ireland. His body was discovered on the shore with a life preserver on. The evidence showed that he died from drowning.

The court held that since the insured did not go down with the ship, nor was he killed by the explosion of the torpedo, it could not be maintained that the explosion was the direct cause of his death.

Holding the evidence sufficient to establish that the injury causing the death was not inflicted by any other person, the court affirmed the judgment in favor of the beneficiary.

CONSTRUCTION OF "NECESSARILY CONFINED TO THE HOUSE":—(Pirscher *vs.* Casualty Co. of America, Court of Appeals of Maryland, 102 Atl. Rep. 546.) The plaintiff was insured with the defendant company under a health policy containing the following clause:

"If bodily disease or illness . . . shall wholly prevent the assured from performing any and every kind of duty pertaining to his occupation, for not less than one week, the company will pay him the minimum weekly indemnity for the period of continuous total disability during which he shall be necessarily confined to the house, not exceeding 26 consecutive weeks."

The plaintiff suffered from an illness which did not confine him to bed or to his home, and went to his office every day for periods varying from a few minutes to a couple of hours. His treatment could not be carried on at home, because of special instruments required to be used at his physician's office. Under these circumstances, the court held that the clear intent of the contract was not to compensate plaintiff in the instant case.

"SEVERANCE" OF HAND:—(Metropolitan Casualty Ins. Co. *vs.* Shelby, Supreme Court of Mississippi, 76 S. Rep. 839.) The insured's accident policy provided for a specific indemnity provided he "sustained the loss of a hand by severance at or above the wrist." The evidence showed that a severe injury had resulted in his losing the use of his hand, to a great extent.

The court held that in the absence of any provision in the policy for loss of use, "severance" could not be construed as a "loss of use" and dismissed the complaint.

WORKMEN'S COMPENSATION.

MARITIME CONTRACT OF EMPLOYMENT NOT SUBJECT TO COMPENSATION ACT:—(Tallac Co. *vs.* Pillsbury, Supreme Court of California, 168 Pac. Rep. 17.) The claimant was hired in San Francisco as second mate for a voyage from San Francisco to a Canadian port. While at the latter port, he was injured in the course of his employment. The Industrial Accident Commission

made him an award under the California compensation law. The court refers to the case of Southern Pacific Co. *vs.* Jensen, 244 U. S. 205, in which the United States Supreme Court held that the New York Workmen's Compensation Act did not apply to workmen injured while employed on steamers engaged in interstate or foreign commerce, upon the ground that:

"Exclusive jurisdiction of all civil cases of admiralty and maritime jurisdiction is vested in the federal district courts, 'saving to suitors in all cases the right of a common-law remedy where the common law is competent to give it.' The remedy which the compensation statute attempts to give is of a character wholly unknown to the common law, incapable of enforcement by the ordinary processes of any court and is not saved to suitors from the grant of exclusive jurisdiction."

The court concluded that the case at bar came squarely under the decision referred to, decided that the commission had no jurisdiction and annulled the award.

(Subsequent to the handing down of this decision, the Johnson Bill was enacted by Congress and signed by the President, becoming law on October 6, 1917. This bill grants concurrent jurisdiction in admiralty cases to state workmen's compensation commissions and to the Federal Courts. The injured employee has the option of claiming compensation from the former or of bringing suit in the latter. Editor.)

SUBROGATION—LIABILITY OF THIRD PARTY:—(Friebel *vs.* Chicago City Ry. Co., Supreme Court of Illinois, 117 N. E. Rep. 467.) The duty of the claimant was to load the trucks at the warehouse of his employer, retail furniture dealers, and to deliver the furniture at the houses of customers. A street car struck the truck without warning, inflicting such severe injuries upon the plaintiff that he became permanently and totally disabled. Although he accepted compensation under the compensation act, he brought suit on the ground that employees of warehouses were not under the compensation act and that he had a right to sue, at common law, the third parties who caused his injuries.

The court held that since neither the plaintiff nor his employer had elected *not* to come under the compensation act, they were automatically brought under it, and that the maintenance of a warehouse in connection with a retail store was a hazardous occupation.

It ruled that his injury arose out of and in the course of his employment, although it occurred while on his return from his last trip after his hours of employment had expired.

The court further held that under the Illinois act, where the employer, employee and third party are all under the act, the maximum that can be recovered from the third party whose negligence caused the injury to the employee, is the amount of compensation for which the employer is primarily liable. The injured employee cannot maintain an action against the third party, as his right to sue is subrogated or transferred under Section 29 to his employer, whose recovery is limited to the compensation for which he is liable. The court finally disposes of the plaintiff's claim that this section is unconstitutional, by pointing out that plaintiff can recover compensation in the first instance from his employer or, secondarily, from the third party whose negligence occasioned the injury.

REFUSAL TO SUBMIT TO OPERATION BARS COMPENSATION:—(Joliet Motor Co. *vs.* Industrial Board, Supreme Court of Illinois, 117 N. E. Rep. 423.) The employee (Goodwin) received an injury to his eye which developed a cataract fifteen months later, resulting in total loss of vision. The employer appealed from an award made for the loss of use of eye by the Industrial Board, upon the ground that a surgical operation would restore vision and that only two days time had been lost. The court held that compensation under the act does not depend upon the loss of time, but is fixed by the act at 50 per cent. of the average weekly wage for 100 weeks. The award was set aside by the court, however, as shown by the following extract from the opinion:

"The statutory provision for reducing or suspending compensation if an employee shall persist in unsanitary or injurious practices, which tend to either imperil or retard his recovery, or shall refuse to submit to such medical or surgical treatment as shall be reasonably essential to his recovery, does not apply to an original application for compensation on account of an entire loss of the sight of an eye, where the question to be decided is whether that loss is due to an unreasonable refusal to remove the cause. The evidence was that the proposed operation would not be attended with any risk, and appears to be such as any reasonable man would take advantage of, if he had no one against whom he could claim compensation, and the board found that it was the duty of Good-

win to have the operation performed. Under that finding, the refusal of Goodwin was unreasonable, and the continued total loss of sight should be attributed to such refusal, and not to the accident.

"The order of the board was not consistent with its finding. If the operation for the loss of sight should be had, and prove unsuccessful, the Joliet Motor Company would be liable for the loss of sight, as well as the surgical and hospital services necessary for the operation and the treatment already received; but, if successful, its liability would be for the temporary loss of time and treatments had, and surgical and hospital expenses necessary for the operation."

MUNICIPALITY NOT LIABLE TO EMPLOYEES OF CONTRACTOR:—(In re Clancy, Supreme Judicial Court of Massachusetts, 117 N. E. Rep. 347.) The deceased was employed by a contractor as a teamster in charge of a horse and cart. The city paid the contractor for services rendered by the deceased employee and his team. The only control exercised by the officials of the city was to inform the deceased what carting was to be done.

The Massachusetts Act provides:

"This act shall apply to all laborers, workmen and mechanics in the service of . . . a . . . city . . . under any . . . contract of hire, express or implied, oral or written."

The court held that there was no contract between the city and the deceased, as the latter drove the team in his own way and was on the contractor's payroll. It restated the legal principle that a driver is a servant of the owner of the horses and not of the one who hires them and affirmed the decision of the Industrial Accident Board denying compensation to the dependents as against the city.

TYPHOID FEVER NOT A COMPENSATABLE ACCIDENT:—(State ex rel. Faribault Woolen Mills Co. *vs.* District Court, Rice County, Supreme Court of Minnesota, 164 N. W. Rep. 810.) The district court granted compensation to an employee who contracted typhoid fever by drinking infected water furnished by the employer in his factory.

The statute provides for compensation:

"In every case of personal injury . . . caused by accident, arising out of and in the course of employment"

and further provides that the term "accident" shall

"be construed to mean an unexpected or unforeseen event, happening suddenly and violently, with or without human fault, and producing at the time, injury to the physical structure of the body."

The court follows the precedents laid down by the English courts in holding that the statute must be construed literally and that it cannot, by implication, be made to include occupational diseases. The supreme court reversed the decision of the district court, because the taking in of typhoid germs did not come within the definition of an accident.

SUNSTROKE A COMPENSATABLE ACCIDENT:—(State ex rel. Rau *vs.* District Court, Ramsey County, Supreme Court of Minnesota, 164 N. W. Rep. 916.) The deceased employee was engaged as a laborer on a very hot day when he was taken with a sunstroke and died a few days thereafter. The definition of "accident" is given in the previous case.

The court again follows the English courts in holding that sunstroke was both an unexpected and unforeseen event and one happening suddenly and violently.

In the following extract, the court distinguishes between this case and the preceding one as follows:

"There is a marked contrast between the sudden and violent effect of a sunstroke and the drinking of water infected with typhoid germs, as it requires days of time after the infection for the disease to develop, as held in State ex rel. Faribault Woolen Mills Co. *vs.* District Court of Rice County, 164 N. W. 810.

"Where the work and the conditions of the place where it is carried on expose the employee to the happening of an event causing the accident, there is no longer a risk to which all are exposed, and the result is an accident arising out of the employment. . . . Was decedent exposed to something more than the normal risk to which men, in general, engaged in manual labor upon the streets, are subjected in hot weather? If he was, then he was exposed to an extra danger arising out of his employment; and if that contributed to the accident, then the accident arose out of the employment. We are of the opinion that there was a substantial abnormally increased risk, owing to the character of the street coupled with its moist condition, which contributed to the cause of the accident."

FREEZING A COMPENSATABLE ACCIDENT:—(State ex rel. Nelson *vs.* District Court, Ramsey County, Supreme Court of Minnesota,

164 N. W. Rep. 917.) The employee was a janitor and in the course of his duties, froze his leg, which resulted in the necessity of having same amputated. In a discussion of the evidence, it was shown that the nature of the claimant's occupation exposed him to a greater risk of freezing than the majority of employees. The court held that freezing was an accident within the meaning of the statute and that the employee was entitled to compensation.

CONSTRUCTION OF "LAWFUL REQUIREMENT":—(American Woodenware Mfg. Co. *vs.* Schorling, Supreme Court of Ohio, 117 N. E. Rep. 366.) The plaintiff alleged that he was injured through the negligence of his employer, in failing to comply with the lawful requirements of the state of Ohio for the safety of employees. He claimed that an action at common law could be maintained under the following amendment of the Ohio constitution:

"For the purposes of providing compensation to workmen and their dependents, for death, injuries or occupational disease, occasioned in the course of such workmen's employment, laws may be passed establishing a state fund to be created by compulsory contribution thereto by employers, and administered by the state determining the terms and conditions upon which payment shall be made therefrom, and taking away any or all rights of action or defenses from employees and employers; but no right of action shall be taken away from any employee when injury, disease or death arises from failure of the employer to comply with any lawful requirement for the protection of the lives, health and safety of employees."

The courts below sustained plaintiff's contention that his case did not come under the compensation law by reason of his employer's negligence. Upon a trial before a jury, a verdict for $2,000 was given the plaintiff. The employer took an appeal to the Supreme Court, extracts from the opinion being as follows:

"It is evident that the paramount purpose of this constitutional amendment was to give authority to the Legislature to pass a compulsory act for the establishment of a state insurance fund to be administered by the state, to which employers should be compelled to contribute, and also to take away any or all rights of action or defenses from employees or employers, with the exception that:

"'No right of action shall be taken away from any employee when the injury, disease or death arises from failure of the employer to comply with any lawful requirement for the protection of the lives, health and safety of employees.'

"When the provisions of sections 13, 15, 16, 18, 21, 22, and 25 are considered together, in the light of the declared purpose of the enactment creating the Industrial Commission, we think it clear that the purpose and the effect of sections 15 and 16 was to bring all employers within the scope of the jurisdiction and authority of the commission, and to impose upon them the obligation to comply with the orders and requirements of the commission when duly made.

"When an order of the commission has been made and complied with, the injured workman will receive at once the compensation provided by the law out of the insurance fund. This could result only in doing justice between the parties, because if the employer has complied with the orders of an impartial official commission, after having posted notice to the employee that he was proceeding under the law and subject to the commission's order, he has done all that in justice should be required. But if he has failed to obey the order or requirement of the commission, made under these general provisions, or has failed to comply with the requirements of any statute or ordinance defining safety devices or safeguards required to be used, he is by that act guilty of negligence per se and liable to the injured workman as provided in the act."

The court held that the plaintiff could not sue at common law, because the commission had not issued any safety orders, which would constitute a lawful requirement, to the defendant employer.

The court denied the right of the plaintiff to sue, as a judgment against the employer would deprive the latter of property in addition to compelling him to insure. The constitutionality of the compensation act is upheld as follows:

"It is a well settled rule in the construction of statutes that where possible such construction will be given as will not render them unconstitutional. In this case, if the construction contended for should be held to be correct, we would encounter the question whether our statutes were thereby rendered invalid, as being in violation of the Federal Constitution, because of the taking of the property of the employer, by compelling him to contribute to the state insurance fund, in violation of the Fourteenth Amendment to the Federal Constitution.

"The United States Supreme Court, in Mountain Timber Co. *vs.* State of Washington, 243 U. S. 219, say:

"'From this recital it will be clear that the fundamental purpose of the act is to abolish private rights of action for damages to employees in the hazardous industries (and in any other industry at the option of employer and employees), and to substitute a system of compensation to injured workmen and their dependents out of a public fund established and maintained by contributions required

to be made by the employers in proportion to the hazard of each class of occupation. While plaintiff in error is an employer, and cannot succeed without showing that its constitutional rights as employer are infringed . . . yet it is evident that the employer's exemption from liability to private action is an essential part of the legislative scheme and the quid pro quo for the burdens imposed upon him, so that if the act is not valid as against employees, it is not valid as against employers.'

"Those decisions are directly applicable to the Ohio Compensation Law."

CONSTRUCTION OF "BUSINESS" OF EMPLOYER:—(Marsh *vs.* Groner, Supreme Court of Pa., 102 Atl. Rep. 127.) The claimant was employed to do a few days' work as a plasterer by a married woman in her own house. He was injured in the course of his employment.

The act reads:

"The term 'employee,' as used in this act, is declared to be synonymous with servant, and includes all natural persons who perform services for another for a valuable consideration, exclusive of persons whose employment is casual in character and not in the regular course of the business of the employer."

The court held that the employer was not engaged in a regular business in having her house repaired, that the employment of the employee was casual in character and therefore claimant was not entitled to compensation.

ELECTION OF REMEDY BETWEEN FEDERAL AND STATE LAWS:—(Jackson *vs.* Industrial Board of Illinois, Supreme Court of Illinois, 117 N. E. Rep. 705.) The deceased was employed as a painter on a railroad which was engaged in both intrastate and interstate commerce. The administratrix of his estate sent a notice of the accident and a claim for compensation under the compensation act to the defendant railroad by registered mail within thirty days of the date of death. This communication was acknowledged five days later by the railroad's attorney, but no settlement was made by the railroad.

Thereafter, the administratrix sued the railroad under the Federal Employers' Liability Act for damages. The Federal Court dismissed the suit on the ground that the facts stated in the complaint showed that the deceased was not employed in interstate

commerce at the time he was killed. The administratrix filed a petition for compensation with the arbitrators, which was granted and confirmed by the industrial board and county court.

Upon appeal by the railroad, the supreme court held that the requirement of the statute that notice of accident and claim for compensation be served on the employer within six months was satisfied by the evidence that the defendant railroad produced the notice of accident upon demand, at the hearing before the industrial board. In affirming the award for compensation, the court stated:

"It is urged with much emphasis that the administratrix was estopped from asserting her claim before the Industrial Board because she elected her remedy under the Federal Employers' Liability Act. The election of remedies has no application whatever in this suit. The doctrine does not apply to concurrent remedies that are not inconsistent with each other and has no application to an election between suits based upon different statutes. Where one has a right of action at common law and also under the statute for the same injury, the bringing of either of said suits is not a bar to the other, and particularly where no recovery has been secured under the one or the other. Apparently in this case the administratrix supposed she had a right of action under the Federal Employers' Liability Act and brought suit under that statute. By the judgment of the court in that case, it was determined that she had no such right of action. She then brought her action for compensation under the state law. A suit under a state law and a judgment therein against the plaintiff are no bar to a suit for the same injury under the Federal Employers' Liability Act, where it appears that there could be no recovery under the state law for the injury. (Troxell *vs.* Delaware, Lackawanna & Western Railroad Co., 227 U. S. 434.) The converse of that proposition is equally true—i. e., that a judgment against plaintiff in a suit brought under the Federal Employers' Liability Act is no bar to an action under a state law for the same injury, where it is determined that the party injured was not engaged or employed in interstate commerce at the time of the injury."

PRESUMPTION OF NEGLIGENCE:—(Mitchell *vs.* Des Moines Coal Co., Supreme Court of Iowa, 165 N. W. Rep. 113.) The deceased was an employee in defendant's mine. Defendant had elected to reject the workmen's compensation law, which provided that under these circumstances

"it shall be presumed that the injury to the employee was the direct result and growing out of the negligence of the employer; and

that such negligence was the proximate cause of the injury; and in such cases the burden of proof shall rest upon the employer to rebut the presumption of negligence."

The court held that the defendant (employer) must overcome the presumption erected by the law in favor of the employee, by proving that it was *not* negligent and that the sufficiency of such proof is a question to be determined by the jury.

CONSTRUCTION OF "ON, IN OR ABOUT" IN COMPENSATION ACT:—(Hicks *vs.* Swift & Co., Supreme Court of Kansas, 168 Pac. Rep. 905.) A truck driver was injured while delivering meat to defendant's (employer) customers. The statute provides that it

"shall apply only to employment in the course of the employer's trade or business on, in or about a railway, factory. . . ."

The court held that claimant was not entitled to compensation, his injury having been received away from the factory, and not "on, in or about" the factory. The court also held that the truck was not a part of the factory, which is restricted to the premises where the manufacturing is done.

CONSTRUCTION OF "ARISING OUT OF EMPLOYMENT":—(In re O'Brien, Supreme Judicial Court of Massachusetts, 117 N. E. Rep. 619.) The employee lost his balance, receiving an injury, while going down a stairway of his employer's factory on his way home at the close of the day's work. The court held that there is a reasonable probability in such circumstances of falls resulting in injuries, which must be construed to be a hazard of the business.

CONSTRUCTION OF "ARISING OUT OF AND IN THE COURSE OF EMPLOYMENT":—(State ex rel. Miller *vs.* District Court, Hennepin County, Supreme Court of Minnesota, 164 N. W. Rep. 1012.) The employee, a messenger boy, while out delivering messages, climbed upon an automobile truck and was injured thereon. The truck was not the property of the employer nor under his control. The court held that while the accident occurred to the plaintiff (employee) in the course of his employment, still compensation must be denied because the accident did not arise out of the employment. The court quoted with approval from the decision of the Supreme Judicial Court of Massachusetts in McNicol's Case, 102 N. E. Rep. 697:

"It [the injury] 'arises out of' the employment, when there is apparent to the rational mind, upon consideration of all the circumstances, a causal connection between the conditions under which the work is required to be performed and the resulting injury. Under this test, if the injury can be seen to have followed as a natural incident of the work and to have been contemplated by a reasonable person familiar with the whole situation as a result of the exposure occasioned by the nature of the employment, then it arises 'out of' the employment. But it excludes an injury which cannot fairly be traced to the employment as a contributing proximate cause and which comes from a hazard to which the workman would have been equally exposed apart from the employment. The causative danger must be peculiar to the work and not common to the neighborhood. It must be incidental to the character of the business and not independent of the relation of master and servant. It need not have been foreseen or expected, but after the event it must appear to have had its origin in a risk connected with the employment, and to have flowed from that source as a rational consequence."

CONSTRUCTION OF "HAZARDOUS EMPLOYMENT":—(Dose *vs.* Moehle Lithographic Co., Court of Appeals of New York, 117 N. E. Rep. 616.) The claimant, a bricklayer, was injured while in the employ of a lithographing plant. Both bricklaying and lithographing are hazardous employments under section two of the law. The award of compensation made by the Industrial Commission was reversed by the Appellate Division, which held that the defendant (employer) did not carry on bricklaying for pecuniary gain.

The definitions in the law are:

"'Employment' includes employment only in a trade, business or occupation carried on by the employer for pecuniary gain.

"'Employee' means a person engaged in one of the occupations enumerated in section two or who is in the service of an employer whose principal business is that of carrying on or conducting a hazardous employment upon the premises or at the plant, or in the course of his employment away from the plant of his employer, and shall not include farm laborers or domestic servants."

The Court of Appeals reversed the Appellate Division and upheld the Industrial Commission. Extracts from the opinion follow:

"The amendment of 1916 was intended to and does embrace an additional class of employees, viz., those in the service of an employer carrying on a hazardous employment, even though such em-

ployee is not actually engaged in a hazardous employment. The claimant, Dose, was clearly within the class embraced in the amended law.

"The injury received by Dose was accidental, and sustained by him as an employee in the service of the company which carried on a hazardous employment. The fact that he was employed in bricklaying, which was not carried on for pecuniary gain by the company, is untenable. A proper conduct of the business of the company required a suitable plant, machinery, tools, etc. The company could not, in justice to itself, its business or its employees, continue business in a plant which was actually unsafe, or in danger of becoming so. Dose was engaged in an employment incidental and requisite to the business carried on by the company, and under the law as amended was clearly entitled to compensation."

WHAT CONSTITUTES PARTIAL DEPENDENCY:—(In re McMahon, Supreme Judicial Court of Mass., 118 N. E. Rep. 189.) The father of a deceased employee made a claim for compensation as a partial dependent. The statute provides that partial dependents shall be awarded such proportional part of the weekly compensation rate for 500 weeks (in no event to exceed $4,000) as the contribution of the deceased to the dependent, bears to the annual earnings of the deceased. The court held that since there was some evidence to support the finding of the Industrial Accident Board as to the partial dependency, it would accept such finding as final; that dependency may exist, even though the father could have subsisted without help and the son was under no legal obligation to assist in supporting his father.

INDEPENDENT CONTRACTOR IN COMPENSATION:—(Carleton *vs.* Foundry & Machine Products Co., Supreme Court of Michigan, 165 N. W. Rep. 816.) The deceased (Carleton) agreed with the defendant to move some machinery from one floor to another, on a time and percentage basis. He hired the men, sometimes he worked himself (in which event he counted his own time at the same hourly rate as his men) and put his bill in for the amount expended for labor plus 10 per cent. Carleton's men were paid by him and their hours were different from defendant's men.

In denying compensation to Carleton's widow, the court wrote:

"We are of the opinion that the test of the relationship is the right to control. It is not the fact of actual interference with the control, but the right to interfere, that makes the difference between an independent contractor and a servant or agent.

"Here the contract did not require the personal services of Carleton. He might work or not as he saw fit. The defendant had no say on that subject, no right of control over him or his time, or his movements. He could go or come as he saw fit. He contracted to produce results through means and men chosen by him, and did not contract for his personal services."

COMPENSATION NOT A VESTED RIGHT:—(Ray *vs.* Industrial Ins. Commission, Supreme Court of Washington, 168 Pac. Rep. 1121.) The injured employee filed a claim for compensation for loss of eye, which it was conceded arose out of and in the course of his employment. Before a warrant was issued to him, he was accidentally killed by causes not connected with his employment.

The statute provides:

"No money paid or payable under this act out of the accident fund shall, prior to issuance and delivery of the warrant therefor, be capable of being assigned, charged, nor ever be taken in execution or attached or garnished, nor shall the same pass to any other person by operation of law. Any such assignment or charge shall be void."

The administrator of his estate argued that the right to compensation survived to his estate, but this was denied by the court, which held:

"This court, in keeping with the universal rule, has held that the test of survivorship of a cause of action is its assignability, and, conversely, the test of assignability is survivorship, which is to say, assignability and survivability are convertible terms.

"Since the assignment of the claim is expressly prohibited, prior to the issuance and delivery of the warrant, an event which did not occur in the decedent's lifetime, or at all, and since the statute further provides, 'nor shall the same pass to any other person by operation of law,' the conclusion seems irresistible that the cause of action does not survive to the personal representative of the deceased, but is a right limited to the injured workman, or his dependents, as defined by the statute."

ANNUAL WAGE OF SEVEN-DAY WORKER:—In re Prentice, Supreme Court of N. Y., Appellate Division, 168 N. Y., Supp. 55.) The New York Compensation Act provides that in the case of six-day workers, the annual wage is to be the product of the daily wage and three hundred. It further provides that where this method can not be applied, that the annual wage is to be such a sum as

would represent the annual earning capacity in the employment at the time of injury; under this provision, the State Industrial Commission had ruled that in the case of seven-day workers, the annual wage was to be the product of the daily wage and three hundred thirty-two.

This ruling came up for review by the court in the case at bar, in which the injured employee was a seven-day worker. The court upheld the commission, because the method used was reasonable and resulted in substantial justice to all parties.

MISCELLANEOUS.

CONSTRUCTION OF "BURGLARY . . . BY THE USE OF TOOLS OR EXPLOSIVES DIRECTLY THEREUPON":—(Blank *vs.* National Surety Co., Supreme Court of Iowa, 165 N. W. Rep. 46.) The plaintiff (Blank) had a burglary policy issued by the defendant, containing the following clause:

"For direct loss by burglary of any of the property described in paragraph A from the safe or safes described in the schedule, located at the premises of the assured, by any person or persons who shall have made entry into such safe or safes by the use of tools or explosives directly thereupon."

Burglars broke into the room in which plaintiff kept a safe, which they opened by working the combination of the outer door. The inner wooden drawers were then broken and the burglars took the money and checks contained therein.

In affirming the decision of the court below for the defendant, the court wrote:

"The rule which requires doubtful or ambiguous language found in a policy of insurance to be construed most strongly against the insurer is so universally known and recognized that reference to authorities to sustain the same is unnecessary.

"It is also the duty of the court, in construing a policy of insurance, to seek to ascertain and determine the exact obligation intended to be assumed by the insurer, and in doing so, language must be given its usual and ordinary meaning, and a construction that is strained or forced should be avoided.

"There is no apparent ambiguity in the language of the policy. The language of the clause above quoted excludes the idea suggested by counsel (for plaintiff). The indemnity provided is against loss resulting from an entry made into the safe by the use of tools or explosives directly thereupon. This necessarily means

the door or outer part thereof. The risk assumed by the insurer contemplates that the door of the safe shall be securely locked, and entrance therein can be made only by the use of tools or explosives for that purpose. This secures the insurer against loss resulting from carelessness in leaving the safe door unlocked by persons having access thereto. The policy is not a general policy providing indemnity against all losses resulting from burglary, but only such loss as results from means employed according to the terms of the policy. The language of the policy certainly does not contemplate indemnity in a case where access is gained to the inner chamber of the safe without the use of tools or explosives, nor against loss resulting from breaking or destroying a wooden drawer which would offer but indifferent resistance to the simplest tools after the outer door has been opened by working the combination to the lock thereon. The policy does not purport to cover all losses resulting from a burglarious entry of the building in which the safe is kept, but only losses resulting from an entry made into the safe by the use of tools or explosives directly thereupon."

CONSTRUCTION OF "AMOUNTING TO EMBEZZLEMENT OR LARCENY":—(Delaware State Bank *vs.* Colton, Supreme Court of Kansas, 170 Pac. Rep. 992.) The plaintiff (bank) brought suit upon a bond given by Colton, its former cashier and against the guaranty company as surety. The guaranty company, under its bond, was to reimburse the bank for loss sustained through Colton's acts as cashier, "amounting to embezzlement or larceny."

The court, in affirming the judgment for the plaintiff, overruled the various defenses set up by the guaranty company as follows:

"The words 'amounting to embezzlement or larceny' do not so far qualify the words 'fraud and dishonesty' as to relieve the surety company from liability until the bank produced testimony which would have been sufficient in a criminal case to convict Colton of one of these crimes. Bonds of this character are to be construed most strongly against the surety company. . . . The surety company prepares the bonds on its own forms, and the courts as a general rule construe them as intended to protect the obligee from loss occasioned by the dishonest and fraudulent acts of the principal, wholly regardless of whether or not the principal might upon the facts established have been convicted of embezzlement or larceny.

"It is contended that plaintiff cannot recover, because of its failure to give immediate notice of the loss as provided in the bond. The loss was discovered on the 15th of May. On the 21st of July, the company was notified, and the court finds that the bank gave notice as soon as practicable. The findings are to the effect that the surety company made no complaint that it was not promptly

notified. It responded to the notice and caused the books of the bank to be examined and made inquiries of the defendant Colton. There is no showing that it was prejudiced in any way by the failure to give notice earlier. Moreover, the court finds that after the surety company had made its investigation, it advised the plaintiff that, inasmuch as Colton denied liability, the surety company would not admit that it was liable. Having placed its denial of liability upon one distinct ground with no complaint in respect to notice, it was too late, after being sued for it, to mend its hold and rely as a defense upon the failure to comply strictly with the condition respecting notice."

PROMISSORY WARRANTY:—(Ellzey *vs.* Massachusetts Bonding & Ins. Co., Supreme Court of Louisiana, 77 S. Rep. 642.) This was a suit to recover upon a bond, in which the defendant company guaranteed the plaintiff corporation against loss through the acts of its president. In its application for the bond, the plaintiff agreed and warranted that the accounts would be verified monthly by the board of directors, also audited monthly by an expert accountant, also keep its account in a specified bank and have checks countersigned by the treasurer. The evidence showed that none of these warranties had been complied with by the plaintiff.

In dismissing the complaint, the court stated:

"The statements thus made in the application is very material to the contract entered into by defendant, and has a very important bearing upon the risk thus assumed by it. It can be viewed in no other light than a promissory warranty, and the law is explicit that the non-observance of a promissory warranty vitiates the contract. Plaintiff, realizing that it had failed to carry out the promises which it made in its application for the indemnity upon which it now sues, advances in argument the equity of its demand; but, we are powerless to assist it in evading or changing the provisions of a contract which it voluntarily entered into, and which constitute the law between itself and defendant."

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

THE THEORY AND PRACTICE OF LAW DIFFERENTIALS—

I. M. RUBINOW.

VOL. IV, PAGE 8.

WRITTEN DISCUSSION.

MR. ALBERT H. MOWBRAY:

This paper covers so much ground in so great detail that it is extremely difficult to discuss it in a small compass. There are, however, a number of points to which it seems to me attention should be directed. The general subject of the actuarial ground work for the next revision of rates is now in the hands of the Actuarial Section of the National Reference Committee and we have had some discussion of the problems brought up in this paper. To some extent, therefore, my remarks may anticipate the work of that section.

Dr. Rubinow opens the paper with the assertion that "the principle of law differentials . . . needs no defence at this time." He does not, however, define precisely what he means by the *principle* of law differentials, although by implication it appears that he considers it to involve a comparison of the cost under two different compensation acts of a common standard set of accidents. It may be that in view of past conditions this method of procedure needs no defense because a better method had not been adopted. For my part I question how far at the present time we are justified in applying this principle if that is precisely what is meant.

At the bottom of page 10 the author refers to the work of Dr. Downey and Mr. Black, then with the Wisconsin Industrial Commission. This work, like my own work, which he refers to in his pamphlet on the standard table, was undertaken not for the purpose of rate determination, but for the purpose of studying comparative benefits under compensation acts. Here I think it is very clear no criticism of the single law differential can be made. As will appear later, I am not so clear as to its justification further.

On page 12 Dr. Rubinow refers to the standard accident table as having saved the situation in New York at the time of the adoption of the New York Compensation Act. It is my recollection that the first New York differential was not determined at all in accordance with the standard accident table. The same general prin-

ciples were used in computations made by Mr. W. W. Greene, then with the New York Insurance Department, and by others whose work was considered at the time the New York multiplier was prepared.

I question whether the author does not claim too much for the standard table particularly in citing the endorsements of it given by the actuarial committee at different rate revisions. At both the conferences the committee was very seriously pressed for time and its recommendations in several respects were not such as might have been expected under more favorable circumstances from the body of men that proposed them.

On page 13 the author takes radical exception to Mr. Ryan's statement in an earlier paper that law differentials would soon have to give way to experience in the determination of rates. The author apparently assumes that the only alternative lies between the determination of single law differentials either on the whole or by classifications, or the use of local experience and the determination of law differentials solely by comparison of pure premiums. I believe there is a third alternative.

The author refers, at the bottom of page 16, to the conclusions of the actuarial committee of the last conference. One factor which was before the committee at that time seems to have escaped his attention, namely, that there have been other factors than law differentials used in passing from basic pure premiums to state pure premiums, and that the use of experience data would tend to eliminate some of these factors. That, to my mind, was one of the greatest advantages which might have accrued from the use of experience differentials.

On page 18 the author presents an exhibit to show the fallacy of the use of experience differentials through a comparison of the pure premium levels between states. I can not conceive of such a state of affairs actually developing in a particular case as is set up hypothetically in this particular table. It seems to me closer adherence to actual fact in the choice of an example would have given the reader more confidence in the fairness of the discussion at this point.

On page 19 the author begins the discussion of some of the features of the standard accident table, which under a certain plan now under consideration becomes of little if any importance. It may perhaps at this time be well to bring to the attention of the Society another method of determining the rates in several different states from combined data.

As we all know, the losses in workmen's compensation naturally divide themselves into certain broad groups—compensation for fatal accidents, compensation for permanent disability accidents, specified indemnity for particular types of injuries in the different compensation acts, temporary total disability compensation, and medical cost. The cost of some of these elements is more or less

closely related with others, and the cost of some is only remotely related to the others, even within the same classification. Our experience data is generally filed so that the losses from the several sources are kept separate and it is, therefore, entirely feasible to determine the relative cost between different states, for example, as respects the fatal accident compensation, or as respects the compensation cost of temporary total disability. It is, therefore, entirely possible to bring together upon a common level the experience of all the states as respects each one of these elements, and to determine a basic pure premium for each of these elements separately. It is also entirely possible to determine a differential by which to proceed from the basic pure premium to the state pure premium for each of these elements separately. I believe this would be much the more logical mode of procedure. It would then be possible to fix upon a basic pure premium in varying groups; determining the medical pure premium, for example, per small group of closely associated classifications; the weekly indemnity pure premium over a somewhat larger group of perhaps less closely related classifications and so on, and determine the death cases from a fairly large group in which the death hazard is, so far as we can ascertain, about equal, but which are not otherwise necessarily closely related. The application of the several differentials to the several elements may be made independently and the state pure premium built up in this way. Under such a system it would be entirely possible to determine the differentials for medical cost directly from experience, and the other differentials from the use of standard tables. Of course, if rates be made by such a scheme the theory of the basic manual will have to be abandoned (except as to uniformity of classifications) as there will be no uniform state multiplier. I believe, however, the gain through the logical soundness in rate-making would more than offset the loss of convenience which might so arise.

It will be at once seen that under such a system of rate-making the relative weight of the several classifications of the standard table as discussed on page 19 and following becomes of little if any importance, the important thing being the correctness of the table within each individual section.

On page 24 the author discusses past methods of valuation according to the standard table. While I have had some work of this kind, others are so much more familiar with the computations referred to by the author that I will not attempt a discussion of this part of the paper, although I might point out that some of the methods referred to at the bottom of page 29 and the top of page 30 seem to me tantamount in many ways to the abandonment of the table as a whole.

On page 35 the author states his objections to the present basis of basic pure premiums. In these I heartily agree with him and it is my personal view that the present New York Act forms a very

much more suitable basis of comparison. The last section of the paper is devoted to a discussion of group differentials as compared with a general differential. While I am of the opinion that in some respects the group differential may be superior to a general differential, I think the methods heretofore suggested in this discussion are superior to either.

While there may be some advantages in the methods of organization suggested by the author I am inclined to believe, until further experiments have been tried, it is hardly necessary to go quite so far.

MR. G. F. MICHELBACHER:

I had hoped to find time to write a discussion of the details of Dr. Rubinow's paper. I find that it will be impossible for me to do so, but I cannot resist the temptation to say a few words on the subject in general.

The problem of law differentials is a big one, for it lies at the basis of most of the actuarial theory in workmen's compensation insurance. The law differential has been used, not only for the combination of state experiences, but also as one of the important factors in the establishment of state rates. In addition, the standard accident table and the law differential calculations have served many valuable purposes in connection with such problems as the valuation of outstanding losses, experience rating and so forth.

Such an important subject cannot be expected to have remained unstudied and undeveloped with the progress which has been made in the establishment of an actuarial theory of casualty insurance. There has come a gradual realization of the difficulties inherent in the theory of law differentials as we have practiced it, and it is certain that at the time of the next manual revision many changes will be made.

From this point of view Dr. Rubinow's paper is historical. He criticizes the old methods of calculation. Assuming that these methods will be largely changed, there is no reason why we should discuss them except as a matter of academic interest. Thus, Dr. Rubinow discusses the selection of a proper basis for a law differential scheme. He presents certain objections against the continuance of the original Massachusetts act as the basic act. No one will take issue with him on this point, for as a matter of fact it already has been decided by the Actuarial Section of the National Reference Committee to recommend a change.

Then again, Dr. Rubinow deals at some length with the problems of valuation which are found in the use of the standard accident table as the basis for the calculation of law differentials. I might take issue with him at certain points of the discussion, but in general I may say that many of his arguments already have been made and that steps are being taken to develop data with which to change the methods of law differential calculation. Thus, the National Workmen's Compensation Service Bureau has inaugurated

as part of its annual statistical program, the filing of wage data. With this information the effect of compensation limits may be more carefully investigated. The Bureau has also called for and will continue to require an analysis of accident experience by classifications. With this analysis of tabulatable accidents by kind of injury, much can be done to correct the standard accident table, and to refine certain methods of valuation which have involved an element of judgment in the past. The Bureau is also studying the cost of medical aid and has developed much interesting information which is being held for the coming manual revision.

So much for the future.

Turning to the past, I should like to point out that the theory of law differentials as it has been practiced has not resulted in any gross inaccuracy.

There has been much controversy concerning the use of a single law differential for the reduction of classification experience. It has been argued that the use of a flat law differential distorts the experience for certain classifications so that the reduced experience is not a proper indication. In answer to these arguments we have the tests which have been made at recent manual revisions which indicate that the established basic pure premiums have closely reproduced the cost of the original Massachusetts act which they were intended to represent. Thus, at the time of the last manual revision it was demonstrated that the basic pure premiums when applied to the Schedule "Z" experience of the Massachusetts Department reproduced the losses of that experience with the remarkably narrow margin of one-eighth of one per cent. Not only was the fit close on the entire experience but it was also satisfactory by schedules.

When the experience for every classification becomes broad enough to serve as the basis for the determination of the pure premium without the use of judgment, the most refined methods of reduction and projection will be necessary. So long, however, as the experience serves as no more than a guide to the pure premium, it is unnecessary to go into refinements so long as the results on the whole are satisfactory.

From the standpoint of projection, the law differential has ceased to be an important factor in those states where experience has been developed in considerable volume. Thus, the general level of rates in the Bureau states has been determined with reference to the actual state experience rather than by a combination of theoretical differential factors. If the theoretical factors produce the desired result, well and good; if not, an experience factor is introduced to force a balance.

One reason why greater progress has not been made in connection with the theory and practice of law differentials is that we have been too busy. In workmen's compensation insurance we always have had more than enough actuarial and statistical work to do.

Revisions of the manual have been made on the average once a year. They have been demanded on short notice, the work has been hurried so that it has not been possible to make extensive investigations of methods and under these conditions, so long as recognized methods produced substantially accurate results, they were continued.

This year, for the first time, we are contemplating a manual revision in the proper manner. We have had almost a year's notice. The Actuarial Section of the National Reference Committee and other committees have been at work for some months and the organization of the work is going on calmly, so that there is plenty of opportunity for study, for discussion and for the investigation of new methods of procedure and new theories of rate determination. The work is not being done by any company or by any interest. It is being done as Dr. Rubinow suggests it should be done, as a public business under the combined auspices of insurance departments, industrial commissions and state rating bureaus.

Under the circumstances it is certain that whatever is done at the next manual revision in the way of the use of law differentials, will be the result of the most careful investigation. This will mark a new page in the history of the subject and for this reason I believe that many of Dr. Rubinow's criticisms and suggestions need not be specifically referred to at this time. They will be answered in what takes place in the development of this subject in the next few months. It is certain, however, that Dr. Rubinow's paper will be valuable in this work and for this reason I for one should like to express my appreciation of it.

ORAL DISCUSSION.

MR. B. D. FLYNN: I should like to take this opportunity to say a few words with regard to Dr. Rubinow's Standard Accident Table. The table has been referred to in a commendatory way at various times during the meetings of the Society, but I have a feeling that many of the members have not appreciated how well this table filled an urgent need in the early days of workmen's compensation in this country. In fact only those men who were engaged in the first actuarial work of projecting rates for the new compensation acts of the various states can appreciate what a useful purpose was served by Dr. Rubinow's table. Founded upon the best of foreign statistics and such American experience as was at that time available it served as a measuring rod of the benefits of the various acts so that "differentials" for the projection of rates could be safely obtained. It is true that in the minds of some there was always a question if the table in certain divisions of injuries was a reliable guide to American compensation experience, but such questions do not affect the usefulness and value of the table for measuring the cost of the scale of benefits of a new compensa-

tion act against the cost of the scale of a compensation act upon which experience had developed. Dr. Rubinow's timely and skillful work in the compilation of this valuable table should receive due recognition.

MR. E. H. DOWNEY: I believe that in the Actuarial Sub-Committee of the Augmented Standing Committee of 1917, several persons suggested a computation of partial differentails in the manner just outlined by Mr. Mowbray. If my memory is not at fault, Mr. Mowbray made such a suggestion at that time, and I believe Mr. Woodward and myself made similar suggestions. As Mr. Mowbray has pointed out, the suggestion was not adopted, partly because of pressure of time and partly because of an inadequate analysis of compensation loss experience. I believe that the method Mr. Mowbray has outlined represents an enormous advance over the crude and inaccurate results of the single law differential. I believe, however, that possibly a still further refinement will give still better results, and such refinement appears to me to be entirely feasible, provided an analysis of statistical experience is made. The difficulty of partial law differentials is that when applied to classifications it introduces a chance variation. A permanent total disability, e. g., is a rare thing. A permanent total disability in New Jersey costs a maximum of $3,000. In New York the maximum would reach $18,000. I think that is within the possibilities. A permanent total disability might as a matter of actual fact have cost only $1,500. From the Rubinow Standard Table we expect one permanent total disability to ten deaths, and one death to one hundred accidents, so that the permanent total disability is very rare, and the classification experience in which there would be an expectancy of five would be a pretty large calssification experience. There are few if any classifications at the present time which show five permanent total disabilities. The mere chance distribution of those permanent disabilities by different states, by ages of the individuals who are injured, by the length of life after the occurrence of the permanent disability—because a man of twenty might die within twelve months—introduces a wide range of pure premium cost for the same number and severity of accidents. The mere chance distribution of those five accidents may produce a variation of 100 per cent. in aggregate cost.

Now I have taken, of course, the extreme case, but something of the same thing happens with regard to death benefits. Under even the Compensation Act of Pennsylvania, the maximum death benefit—or rather the largest amount as yet awarded in any case—is about $8,500. As an opposite extreme there are many cases which cost $100. The variation between states in cost of deaths to persons having the same number of dependents is also wide, so that you have there again a very large chance element. You have a similar chance element in the case of partial permanent disabilities. Permanent partial disabilities are more numerous than

deaths, and their cost varies greatly from causes which have little connection with the nature of the injury itself. In Pennsylvania, e. g., the total loss of the hand would be compensated by 215 weeks, but a 50 per cent. disability of the same hand would in all probability be compensated only as a temporary disability. That is not what the law contemplates, but that is what is done and what appears in your pure premium experience. The same thing holds true in other states. A great many cases of what are actually permanent disabilities are compensated as only temporary disabilities. This is due to administrative defects. You have here a large element of chance deviation.

Now it seems to me that these monetary fluctuations can be largely done away with by basing our pure premiums on the number and severity of accidents rather than the magnitude of monetary loss.

If, e. g., you take the logging experience of the compensation states, you will get a certain large payroll exposure. Against this exposure you will have a large number of deaths; also a considerable number of permanent total disabilities, that being one of the industries in which they concentrate; also a large number of permanent partial disabilities, a large number of temporary compensatable disabilities, and so on. A distribution of these accidents in that industry could be made on a basis similar to Dr. Rubinow's Standard Distribution. To obtain the pure premium for Pennsylvania, value the accidents which have occurred in the logging industry of all states on the Pennsylvania scale of benefits, as determined not by theoretical computation of the law differential, but by the actual experience of the state for similar injuries. This will give you a good basis for valuing deaths, disabilities of all kinds, and medical cost. It seems to me that this method, while at the first glance it appears to involve more work than even Mr. Mowbray's method—in practice I don't think it would involve more work, once the table were constructed—would, I believe, give results which would be more defensible than would ever be arrived at from monetary pure premiums alone.

It should be mentioned, of course, that the problem of law differentials does not arise with respect to a classification which in a given state produces sufficient exposure for sound rate-making. No one, I take it, would wish to combine the Pennsylvania bituminous coal mine experience with the experience of any other state for the purpose of making Pennsylvania rates. No one, I think, can rationally argue that the addition of the California, Maine and New York logging experience adds anything of value to the Wisconsin logging experience. In these cases the gain in volume of exposure is much more than offset by the loss of homogeniety. At most it would be reasonable to combine the logging experience of the Great Lakes states. But the problem of law differentials does arise with respect to the logging industry in Penn-

sylvania, which certainly does not produce a sufficient exposure for rate-making. For these minor industries—and their name is legion—the total experience of the state with respect to the cost of particular injuries is a better basis of valuation than the monetary loss experience of the industry for the country as a whole, while the number and severity of injuries per unit of exposure for the industries of the country as a whole is the most suitable basis —indeed the only possible basis—for predicting the number and character of injuries per unit of exposure in that industry in the given state.

I should like to add that the problem of projecting rates is the problem of predicting the number and severity of industrial accidents per unit of exposure. The probable loss cost is based upon the probable number and severity of accidental injuries, and the past monetary loss cost is a trustworthy basis of prediction only insofar as the corresponding accidental injuries are likely to be reproduced. When we are dealing with very large exposures it may reasonably be assumed that the chance deviations in monetary loss cost will cancel each other, at least to a large extent. But when we are dealing with those classifications in respect to which the problem of law differentials arises, this assumption is unwarranted.

MR. J. H. WOODWARD: Referring to this question of the monetary loss *vs.* the number and kind of accidents as the basis of differential calculations, it seems to me that Dr. Downey's hopes that it will ever be feasible to make a satisfactory analysis of these statistics upon the basis of the number and detailed description of accidents for each classification are not likely to be fulfilled. In practice, what we are finally interested in is the number of dollars that it costs to pay compensation in a certain state and in a certain classification, and if, as now seems probable, we are going to get compensation costs divided into death, permanent disability, temporary disability, and medical, for each classification and each state, we are going to get all that can be reasonably required—certainly for the time being.

I think that this discussion, and also Dr. Rubinow's extremely interesting paper, has shown how far we have progressed since the Rubinow Standard Accident Table was originally promulgated. One of the striking features of the paper, and one which is extremely creditable to the author, is the indication of progressiveness in ideas on his part. Incidentally it seems, in the light of what we have come to realize are the difficulties of the subject, rather odd to think how many persons hailed this table when it was first put out as something that would do for workmen's compensation insurance those things which the American Experience Mortality Table has done for life insurance. Of course, that expectation was bound not to be fulfilled. This is not saying that the table was not as good a table of the kind as could be constructed at that time, or that it did not serve an extremely useful purpose. It simply

means that the problem is entirely different and there is not any analogy at all between the Standard Accident Table and the American Experience Mortality Table—that, in fact, the word "standard" applied to the accident table is to a certain extent a misnomer.

MR. G. F. MICHELBACHER: I must admit that Mr. Downey's proposal to use a combination of accident experience, rather than a combination of loss experience, for the determination of state rates, is one which I have never heard discussed before. I wonder, however, whether the proposed method will cure the evils which it is designed to eliminate.

So far the law differential has been used for two purposes—for reduction and projection. By reduction is meant the process of reducing the losses of the different compensation states to a common level, so that the experience of each classification for the United States may be pooled and thus made available in the greatest volume for rate-making purposes. By projection is meant the process of taking the basic pure premiums established upon the combined experience of all states and translating them into state pure premiums, which are used as the basis for the calculation of state rates.

It is only in the process of reduction that the problem of incomplete experience is found. Naturally there will be but little experience in many classifications in an individual state. The losses in these cases will be incomplete and abnormally distributed to the several types of injury. It follows, therefore, that a method of reduction must be adopted which will give proper weight to the losses by injury divisions, for otherwise there would be some distortion of the experience in the reduction process.

In projection on the other hand, it may be assumed that the basic pure premiums are complete, for if there are any loss elements missing in the basic pure premium experience, they are supplied by underwriting judgment or by actuarial calculation. Thus, if there are no death losses in the experience for a certain classification, this element is supplied by the committee which establishes the basic pure premium. In projection, therefore, there is no problem of incomplete experience or incomplete pure premiums.

If I understand Mr. Downey's proposal correctly, it is designed to avoid the difficulty occasioned by incomplete experience. He would take the accidents by classifications and merely combine the results. In this way the experience for any classification for the United States would be obtained without the necessity of reducing the separate experiences to a common level. For projection, Mr. Downey would employ a method of valuing the accident distribution for each classification upon the basis of experience for the individual state. The method of valuation would undoubtedly involve the accumulation of Schedule "Z" data by kind of injury.

Under this plan the basic pure premium for the sawmill classification would be obtained by taking the standard distribution of

accidents by kind of injury and applying this to the distribution of losses ascertained from Schedule "Z" experience.

I question whether this will solve the difficulties which we find in the present system.

In the first place, what will be done to complete an accident distribution for a classification for which the United States experience is obviously incomplete? Loss elements may be supplied by judgment where the experience is inadequate. If the problem were refined and placed on the basis of accidents, I doubt whether the inadequacies of experience data could be accounted for in this manner.

In the second place, how shall we determine the division of loss cost for the state from Schedule "Z" experience? Shall we take the combined results for all classifications, or shall we rely upon the indicated results for the individual classification? If the first method is adopted, an error undoubtedly will be made, for, as is well known, the cost per case of the various benefits is decidedly different in different industries. Thus, the cost per case of medical treatment varies considerably by classification and the same is true of the cost per case of temporary disability cases, dismemberments, and so on.

If these costs were determined by the combined results for all classifications, they would be wrong for the sawmill classification. The proposed method would require the application of the division of loss cost to the distribution of accidents for the sawmill industry. In this case the result would be fictitious and incorrect.

If the second method of determining the distribution of loss cost were followed, the situation would be as difficult as the present one, for we should be in the position of establishing rates for the majority of classifications upon inadequate experience. Thus, if the Schedule "Z" data for a state for the sawmill classification were incomplete, how could a valuation of compensation cost be made?

Finally, I can see trouble connected with the proposed method from the standpoint of the approval and justification of state rates. The supreme test of the accuracy of a state rate has been the loss experience indication for the state. This has been the reason for the various state Schedules "Z." It would be exceedingly difficult, if not impossible, to apply this test if the division of losses ascertained for the state for all classifications or for a single classification were applied to a hypothetical accident distribution for an individual classification. If the comparison of the hypothetical rate with the actual indicated pure premium for the classification were out of line, the actual experience would be given preference and inasmuch as it is likely that the number of these cases would be considerable, owing to the possibilities of error which I believe to be inherent in the proposed method, it is not probable that rates produced in this manner could be adequately justified and substantiated to the satisfaction of supervising authorities.

MR. I. M. RUBINOW:

(AUTHOR'S REVIEW OF DISCUSSION.)

In reviewing the numerous interesting discussions by several prominent members of the Society, I am unfortunately laboring under a very serious handicap. For over half a year I have been kept away from New York and from personal contact with the compensation insurance business because of my effort "to do my bit." I am, therefore, not sufficiently familiar with the recent developments and plans for the changing of the entire system of compensation rates, so frequently referred to by those who took part in the discussion.

Briefly, these discussions may be classified under the following three heads:

1. General objections to my claiming too much for the method of law differentials and my own services in connection therewith.
2. Detailed criticisms of various technical points discussed in my paper.
3. Statements of the new and better methods of deriving compensation rates, now being elaborated by the various actuarial committees.

The first issue, being largely a personal and insignificant one, can be readily disposed of.

Nowhere in this paper, or any where else have I claimed the virtue of perpetual infallibility, either for the method of law differentials or for the Standard Accident Table. The comparison of this Table with a Mortality Table was but a highly exaggerated compliment paid by others to my work (I believe Prof. A. W. Whitney was the first to suggest that phrase) perhaps because at the time (1914) it did solve a great many vexing problems. It was Prof. Whitney who suggested the advantage of a differential system, but the method of arriving at one had been worked out by me, and in fact suggested as early as 1911 and my files contain very complimentary letters from many students, including Mr. Mowbray, to the effect that my first article on the subject did furnish a method of computing compensation costs (and rates after all are necessarily an expression of costs) which they had been at a loss to formulate.

And whatever elements of inaccuracy the method has developed, no matter how many changes and improvements have since been suggested, I believe an impartial valuation of the services performed by the Differential Method and by the Standard Accident Table cannot afford to disregard the fact that after four years it is still today the official basis of almost all compensation rate computations, and the actual changes introduced since 1914 have been rather slight. The method has not only been approved by actuarial committees, but by most of the state authorities intrusted with the

duty of controlling compensation rates. Even Dr. E. H. Downey in his very severe arraignment of the present methods of calculating compensation rates (*Journal of Political Economy,* December, 1917). "The Making of Rates for Workmen's Compensation Insurance" is forced to admit: "The most that can be said for this method is that no better basis has as yet been devised for estimating the relative cost of compensation laws *in advance of experience.*" That, however, was precisely the problem to be solved in 1914. One is, therefore, somewhat at a loss to understand Dr. Downey's scathing reference to "the crude and inaccurate results of the single law differential."

Mr. Mowbray objects to the claim that the Standard Accident Table "saved the situation in New York at the time of the adoption of the New York Compensation Act," and points out that the first New York Differential was not determined in accordance with that table. In justice to myself, may I state that at no place in my paper was this claim made and the sentence referred to by Mr. Mowbray reads:

"It may be recognized that the Standard Accident Table at that time saved the situation for the entire compensation business."

The Actuarial Committee was appointed and the Table prepared after the New York Act went into effect. It is true, however, that the method of obtaining a differential between the two acts (Massachusetts and New York) was suggested to Mr. W. W. Greene by myself, the Austrian distribution being used, since there was no accepted standard table.

2. As to the substantial points raised by the paper, their discussion, very much to my regret, is not as complete as I might have desired. Nevertheless, in regard to some points, as the valuation of medical costs and the effect of wage influences, I am glad to know that these are being taken into consideration and perhaps my paper was not without some assistance in the matter. I think it extremely significant that such a prominent authority as Mr. Mowbray is on the subject of compensation rates, avoids the discussion of the methods of valuation on the plea that "others are so much more familiar with the computations." Yet all the rates in the past have been based upon differentials, and the differentials necessarily upon the methods of valuation. To me it offers strong evidence that at least in the past the entire organization of differential work was not entirely satisfactory, too much being accepted on faith. At least every time I was forced in the capacity of a consultant, to disagree with personal friends and co-workers of yesterday, in regard to rates, the question most frequently at issue lay in these very details of computation.

Mr. Mowbray makes the point that my illustration of the possible results of the experience differential is artificial, improbable and therefore not convincing, and recommends "closer adherence to actual fact in the choice of an example." This, of course, is a

point well taken. But actual facts of experience have not been published in such detail as to be available to the outsider. Besides, the illustration had to be made simple and schematic. Yet actual experience as far as available does play tricks like that. Here is for instance the pure premiums for different years even within the same state. I am taking the two Wisconsin reports giving pure premiums for 1911–1913, and 1914, picking out the comparative classifications as they come, without any selection.

	1911-13.	1914.
Lead and zinc mining	3.50	2.68
Quarrying	1.44	2.58
Glue manufacturing	1.37	.49
Paint	.45	.72
Soap	.76	.38
Brick	1.46	1.49
Stone cutting	.72	.63
Bakeries	.55	.31
Breweries	.83	.90
Candy	.15	.27

The pure premium is therefore greater in 1914 in five and smaller in the other five classifications, some pure premiums being 80 per cent. greater and others 65 per cent. smaller. And yet only on classifications with a substantial exposure are these comparisons available and it being the same state, the fluctuations in payroll are insignificant.

Classification.	Massachusetts.			Wisconsin.			Differential.
	Payroll.	Losses.	Pure Premium.	Payroll.	Losses.	Pure Premium.	
Stone cutting...	$1,218,242	$88,074	.66	$762,700	$ 5,508	.72	1.09
Bakers	2,357,665	8,187	.35	707,800	3,906	.55	1.57
Brewers	1,572,542	20,229	1.29	3,977,900	32,975	.83	.64
Candy manufacturing	2,178,719	7,344	.34	498,000	764	.15	.45
Cigar manufacturing	652,300	934	.14	665,240	19	.003	.02
Boot and shoe...	42,264,508	50,641	.12	2,891,200	11,014	.38	3.17
Brass goods	759,465	4,188	.55	198,000	286	.14	.25
Elec. apparatus..	1,071,331	2,753	.26	381,100	436	.12	.45
Foundries	1,760,051	9,553	.54	1,409,300	13,563	.96	1.78
Jewelry	4,832,453	7,511	.16	200,700	248	.12	.75
Total of 10 classifications	$ 58,667,276	$ 119,414	.204	$ 11,692,040	$ 68,719	.587	2.88
Total exposure, all classifications	429,739,137	1,295,449	.301	113,498,500	926,323	.816	2.71

In order to test the influences of such accidental fluctuations, I have made a further comparison of the experience of ten comparable classifications for Wisconsin and Massachusetts (experience of 1911–1913 policies inclusive), selecting the first ten in the Wisconsin list for which such a comparison could be made.

The results are startling, to say the least. The general pure premium for Massachusetts was .301 and for Wisconsin .816, indicating a differential of 2.71. Taking these first ten classifications, the Massachusetts pure premium is .204 and the Wisconsin pure premium .587, indicating a differential of 2.88. The fluctuations in the experience differential for individual classifications are from .02 for cigar manufacturing to 3.17 for boots and shoes.

Applying the same methods as used in the table on page 11 of the *Proceedings,* the following results are obtained. The Massachusetts payroll, with the Wisconsin pure premium produces an average pure premium of 1.39 and a Wisconsin Differential of 1.87. The Wisconsin payroll with the Massachusetts pure premiums produces an average pure premium of .641 and the differential for Wisconsin figures at $(.587 \div .641) = .91$.

Finally, if the two payrolls are combined, and either series of pure premiums is applied, the average pure premium for Massachusetts becomes .276 and for Wisconsin .414, producing a differential for Wisconsin of $(.414 \div .276) = 1.50$.

Here then we have the following experience differentials: 2.88, 1.87, .91 and 1.50, showing a variety as great as that quoted in my purely hypothetical illustration. The fact that one of the methods produced 1.50 (the old Wisconsin differential) may point to the fact that this is the best method (adding both payrolls, applying both series of pure premiums independently, and comparing the losses thus computed) but then again this result may have been purely accidental. In any case, Mr. Mowbray's objections to the use of the hypothetical illustration falls to the ground and the illustration from actual experience plainly shows the gross inaccuracy and thorough unreliability of the so-called experience differential.

Furthermore, Mr. Mowbray points out my failure to define the *principle* of law differentials. Formal definitions are proverbially difficult, but surely there must be some agreement as to the nature of this method among all those actuaries who still persist in using it. Else how can they justify the rates computed by them for two score states from one common set of basic pure premiums?

The very purpose of the paper, however, was not to take credit for past performances, or to stand pat in defense of old methods, but to subject both the method and the result to some critical examination. I am extremely gratified that Mr. Woodward has so clearly perceived this purpose.

The table itself should, if it is to continue in use, be carefully revised, and the method of group differentials be made possible by

some simple system of providing for modification of the Standard Table for group purposes.

3. The references to latest developments in rate-making, made by several gentlemen participating in this discussion, are most interesting. Unfortunately, they are not equally clear or sufficiently explicit to permit any judgment by anyone who is not within the inner circle of actuaries working on this problem.

I find Dr. Downey's discussion in this respect least definite. His suggestion for "partial differentials" in no way changes the differential system, except that it introduces a refinement in the method of reduction of experience, a refinement which is on the whole unobjectionable. Dr. Downey is afraid of the "chance element." But after all, if one deals with insufficient experience in any one state, then that experience is all "chance," and the chance element due to the wage conditions or marital relations is no worse than the chance element in accident frequency itself. It is necessary to remember that the cost of compensation (and therefore the rate) does depend upon these wage and marital relations as much as upon accident frequency and that compensation rates are not a fine for accidents. If, for instance, the lumber industry employs a larger proportion of single men, its cost for fatal accidents will be lower, and therefore its rate lower than it otherwise would be though the social cost in accidents and loss of life and suffering may be greater.

I fail to see that Dr. Downey's suggestion of deriving the rate from accident experience direct instead of cost experience will reduce the number of difficulties. To begin with, it will require a volume and excellence of accident experience which will probably remain a utopia in this country for some time to come. And even if that is available, it is, I believe, at least as inaccurate as is the Standard Accident Table, to assume that the "actual experience of the state for similar injuries" would hold true for each classification because it holds true for the state as a whole. In any case, the same logical error is committed, which is charged against the Table.

In his article already cited here Dr. Downey says:

"A flat law differential, in truth, rests upon an assumption which is clearly contrary to fact—the assumption, namely, that the distribution of severity of work injuries is the same for all injuries. . . . Unfortunately, for the hypothesis, the facts are notoriously otherwise."

In justice to all those who contributed to the elaboration of compensation rates, it might perhaps be pointed out that this shortcoming was clearly recognized. Not only is it clearly stated in my paper under discussion, but also in the first paper on the subject published in 1914. (*Proceedings,* Vol. I, p. 10.) The flat differential rests therefore only upon a "working assumption," the inaccuracy of which has been thoroughly recognized all along.

What I have tried, however, to explain in my paper, in definitely advocating "group accident tables" and "group differentials," was that while this assumption does introduce an element of inaccuracy, which can by this time be eliminated, that element of inaccuracy is not as great as might be imagined at first sight (see my discussion, pages 37–40), and that the reason experience differentials of many classifications widely differ from the general law differential is because of the insufficient experience of individual classifications in separate states, introducing a chance element of accident frequency. If in bringing together the experience of many states, the number of accidents were studied as well as the losses, these wide chance fluctuations would become very obvious.

May I conclude by expressing my deep appreciation of the statements made by several speakers, notably Messrs. Flynn and Michelbacher, concerning the value of the differential method and the Table, at least in the past. So much experience has been accumulated during the last five years and so many able minds have labored over the problems of compensation rate-making, especially under the stimulus for scientific research, furnished by this Society, that what constitutes a new branch of science has been created in an amazingly short time. But while temporarily, at least, deprived of an opportunity to contribute to it, I need not be criticized for deriving a certain amount of satisfaction from the knowledge of having contributed something to the foundations of this new science, nor for desiring to cooperate in the further perfection of this structure.

PREMIUMS AND RESERVES OF THE SWISS ACCIDENT INSURANCE INSTITUTION—JOSEPH H. WOODWARD.

VOL. IV, PAGE 45.

WRITTEN DISCUSSION.

MR. BENEDICT D. FLYNN:

We are greatly indebted to Mr. Woodward for bringing to our attention this interesting and instructive outline of the methods used by the Swiss Accident Insurance Institution in the computation of workmen's compensation rates, the rating of risks and the calculation of reserves. To the writer it was particularly interesting to learn how closely the Swiss actuaries have paralleled the best thought in this country in the solution of the many problems of this business. The paper not only gives to the men engaged in the actuarial and underwriting work of workmen's compensation insurance in this country a new realization of the universal character of the problems with which they are dealing, but is also a source of encouragement to them in showing that the solution of these problems reached abroad after many years of experience and study so nearly approach the solutions obtained, or which are being worked out, here.

The method by which the Swiss actuaries worked out their "differential" problem—meaning the problem of relating the experience of one set of compensation benefits to the basis of another—approximates to some extent the actuarial work of this kind carried out in this country. The method of the Swiss actuaries was, briefly, to divide the total claims under a compensation act into certain major divisions of benefits, to weigh the cost of each of these divisions according to the old and the new scale and to obtain a "coefficient of transformation" or differential in order to relate one scale to the other. The divisions of claim costs were made for each industrial classification and by applying the differential for each division, an average differential to cover all of the benefits for the particular classification obtained. In the early work in the United States an estimate of the cost of all divisions of benefits was made, but a single average differential for all classifications was obtained and used. I will not attempt a lengthy explanation or justification of the single differential method as applied in the early work in this country. Dr. Rubinow, in his recent paper upon the subject (*Proceedings,* Vol. IV, p. 8) has gone into this matter fully and has shown that paucity of experience, urgent necessity for quick results and the particular problem of projecting rates for new com-

pensation rates practically necessitated this method of treatment. I believe too that it was brought out clearly at the last general revision of workmen's compensation rates that the system of expense loading which had been in vogue fitted well with a single differential method and that to utilize differentials varying by classifications without changing the method of expense loading would give dangerous results.

The detailed method and the basis of the important work of estimating the cost of the particular benefit under the new act is not given. It is generally known that in this country the Standard Accident Table compiled by Dr. Rubinow served as a most valuable basis for this sort of work. It is to be presumed, however, that adequate statistical data for measuring the cost of the various major divisions of benefits under the new act were available to the Swiss actuaries. It is to be presumed also that the Swiss actuaries were aware of the danger of utilizing experience data which was not fully developed in a plan which called for a division of total compensation cost into major benefit divisions. At the last general revision of compensation rates the danger of dividing the total cost when the claims were still in the temporary total division which later would reach the permanent total division, or possibly death division, was apparent. I believe it is safe to say that the general method pursued by the Swiss actuaries is that which actuaries in this country have felt for some time was the best solution of this troublesome problem.

It might be pointed out at this time that the future differential work in this country should present a much easier problem in view of the fact that not only will experience be available for measuring the weight and average cost of the particular benefit under one act, but will also be available for measuring these factors in connection with the act to which the first experience is to be related. In fact it may possibly be unnecessary in certain large classifications to utilize a differential but simply to use the experience in certain divisions, such as medical, of the state.

The rates of the Swiss Institution are loaded by the method of percentage loading plus a constant. This plan of expense loading so well set forth in Mr. Woodward's paper (*Proceedings,* Vol. III, p. 140) was fully considered at the last general rate revision, but because of the fact that it was a practical necessity at that time to utilize singe law differentials it was not adopted. In Pennsylvania, however, at the present time a method which follows the percentage loading plus a constant plan has been used in calculating the manual rates. At the next general rate revision it is probable that this method will receive favorable consideration together with the method of differentials by industrial classifications.

It is most interesting to note that the manual rules with regard to classification of risks and division of payroll follow so closely the American practice. Some of the rules of payroll division differ

somewhat, as, for example, the much discussed box and container manufacturing classification is considered as not incidental to the general classification by the Swiss and is rated separately, whereas it is now considered as incidental in this country and is not rated separately. On the whole, however, the rules are remarkably similar in the two countries and the underlying principles of classifying risks are practically the same.

The division of enterprises into large and small, i. e., the latter containing ten or less employees, is interesting as regards its bearing on the minimum premium problem in this country. Mr. Woodward does not tell us if the smaller enterprises carry a higher rate than those in the same industrial classification with a larger payroll. Although we can see another distinct purpose in this division of risks into large and small, namely, to indicate whether or not the work should be considered as incidental to the main enterprise, it seems reasonable to believe that this is the manner in which the Swiss Institution meets the undoubtedly heavier cost of the very small risks.

The Swiss method of classifying risks by hazard utilizes 350 classifications, each of which may carry seven different rates representing what is described as "a degree of risk" within the classification. This in a way approaches the American method which employs something like 1,500 classifications. Although in this country almost innumerable variations of the classification rate can be obtained through schedule and experience rating, the principal point of interest in comparing the two methods of rating seems to be that under the Swiss plan a risk in a certain classification may obtain a rate as great as three times that of another risk in the same classification. Under schedule and experience rating in the United States the maximum range is from 40 per cent. below manual rate to 40 per cent. above, although the new experience plan which is now under consideration by various states places no absolute limit upon the range of the rate—although the method itself automatically effects a satisfactory check. The explanation may be that there are certain classifications in the Swiss manual, for example, Machine Shop with Foundry, and that under this classification in the plan of rating by "degree of risk," Typewriter Manufacturing is placed at one extreme and Mining and Milling Machine Manufacturing at the other, while under the American plan each of these risks would be placed in a separate and distinct industrial classification. It is probable that with a full explanation of the Swiss rating plan we would find that the rating given to a particular risk would not differ greatly in the two countries.

Mr. Woodward states in referring to the Swiss method of rating: "In general the first consideration in determining the degree of risk is the previous accident experience for the enterprise," and further: "It is emphasized that for large industries first importance

should be given to the statistical history." The conclusion by Swiss actuaries that experience is the dominating factor in rating risks, particularly in large enterprises, is gratifying to those of us who have for some time felt that experience rating which reflects both the moral and physical hazards should receive due recognition as the most important factor in obtaining the adjusted rating.

The factors considered in fixing the degree of risk are mainly those which are covered under the schedule and experience rating plans of this country. Certain of these, however, such as "nationality of the employees," "the proportionate number of apprentices and young workmen in relation to the total number of workers," "the proportionate number of female workers as related to the total workers," are not considered in this country except as to their effect as shown in the experience rating plan. This statement may be modified, however, by stating that in the schedule rating plan the number of operators on machines might give an idea indirectly of the number of apprentices. Some of the factors mentioned, such as "the proportionate amount of wages of office employees as related to the total wages" and "supplementary insurance"—not referring to boiler insurance or similar lines—are not to my knowledge utilized in connection with the rating scheme in this country.

An inspection of the rates shown in the comparison between those of New York and the Swiss Institution would lead one to think that the New York rates followed more logically the relative hazards of the particular classifications, but conclusions from this would probably be misleading as we are not certain that the industrial conditions are the same in both countries. It is interesting to note that in the majority of classifications New York rates are shown to be lower than would be indicated by a rough differential between the two scales of benefits.

The problem of reserve calculation differs so much from that generally met in this country because of the difference in the type of benefits in the two countries and in method of claim administration, that we cannot obtain much light from the Swiss plan. There are no specific benefits payable for certain types of injuries in Switzerland which can be compared with the benefits for dismemberment or loss of use under most of the acts in this country. All permanent disabilities which are not total are valued according to the judged degree of impairment in earning capacity, and consequently the rate of revision of compensation is the important factor. Incidentally, when we consider that the great majority of permanent disability cases fall into the class of dismemberment or loss of use, we can see the immense amount of work and the responsibility assumed by the Board which adjusts and revises the compensation payable in these cases in Switzerland. The payment of specific benefits in this country, although they may in certain cases not follow the merits of the case closely, certainly simplifies greatly

the adjustment work. So far as those cases which do not fall into dismemberment or loss of use class, the problem of the Swiss actuaries is similar to that which we have at the present time in this country. It is interesting to note that they have not attempted to apply tabular valuations to temporary disability cases. Apparently a case of this class runs along upon temporary disability and at some time is assigned to the permanent disability class. Mr. Woodward does not state if this occurs automatically at the end of a certain period of duration of claim, as, for instance, one or two years. The decision of the Board handling the revision of these cases in Switzerland is a most important help in working out a valuation plan of this kind. The absence of similar authorities in all states in this country for revising the indeterminate claims will, I believe, prove a considerable difficulty in working out a plan of tabular valuation of outstanding workmen's compensation claims. It is clear that the tabular values used must be derived from cases handled in the same manner as the outstanding cases which are to be valued.

The only possible criticism of the method used by the Swiss actuaries in the valuation of outstanding claims which might occur to one is that the change from the present values of disability annuities used during the first three years, when the age of the annuitant is disregarded, following date of injury changes too abruptly from the third to the fourth years of payment. It would seem advisable to arrange the select valuation table by broad groups of ages so that the change from Table A to Table B would be less abrupt. For instance, if the annuitant is age 25 at the date of injury, the valuation factor at the end of the third year is 12.929, but at the end of the fourth year a factor of 16.020 is necessary, an increase of approximately 24 per cent. Then again if the claimant happened to be an old man, say age 55, the valuation factor would be increased approximately 30 per cent.

The use of select tables in the valuation of disability annuities, even disregarding ages of annuitants in the first years of disability, is in the opinion of the writer a wise plan. Taking this lesson from the Swiss work it would be advisable for us to have in mind and to utilize so far as possible in the valuation of outstanding claims the select table idea. For instance, in the valuation of compensation payments to a totally and permanently disabled worker undoubtedly a select table of mortality upon the disabled life should be used. Further, it would be advisable as soon as adequate experience is obtained to make up remarriage tables upon a select basis.

Bearing upon the remarriage rate, the writer agrees completely with Mr. Woodward in his concern regarding the proper remarriage rate to use in the valuation of annuities to dependents which involve this factor. In the valuation of outstanding claims to widows under the New York act the remarriage factor is predominant. The Dutch Royal Insurance Institution (1912) gives

the lowest rates of remarriage, but we should endeavor as soon as possible to obtain light upon the rate of remarriage among the widows of American workmen. This is particularly important in view of the social after effect of the war which will undoubtedly greatly reduce the rate of remarriage among widows.

MR. MARCUS MELTZER:

All who have had some part, however remote, in compensation rate-making will, I am sure, agree with me that we owe a debt of gratitude to Mr. Woodward for giving us such a clear and comprehensive description of the methods followed by the Swiss actuaries in establishing rates for the coverage of compensation under the insurance law of Switzerland. Our Society is fortunate indeed in having as a member one who is not only deeply interested in the solution of our compensation problems but who is so well qualified to study and interpret for our benefit the work of European actuaries.

If I am at all in a position to judge, Mr. Woodward's paper has already had far-reaching results. We all are cognizant of the general dissatisfaction with the hurried work of the last conference on rate revision. The exigencies of the situation required an immediate adjustment of compensation rates. There was no time nor sufficient statistical data available for a scientific treatment of some phases of the work, particularly the actuarial, though the need for improved methods was apparent to all. Certain definite proposals made at the time, which might be said to have anticipated certain features of the Swiss methods, could not be entertained for these reasons. The dissatisfaction grew, but there was lacking a coherent, organized movement to meet the situation. Of late, however, there has been noted a crystallization of effort along definite lines which is certain to eventuate in pronounced improvement in the actuarial methods, and this can be justly attributed in great part to the stimulus furnished by Mr. Woodward's paper.

Mr. Woodward has so admirably attained his aim in this presentation of the Swiss problem and its solution that there is no room left for comment on the subject matter.

However, in justice to the underwriters and actuaries who took part in the last rate revision, I should not pass over without criticism some of the author's comments which appear in the footnotes. To call our methods of computing pure premiums crude, and to make disparaging comments on the arrangement of classifications in our manual without at the same time pointing out how radically different the conditions are in the United States, unjustly places our actuaries in an unfavorable light.

The Swiss actuaries were dealing with a comparatively simple problem—the transformation of one set of rates into only one other. There were only 350 classifications to be dealt with. The Accident Insurance Institution of Switzerland represented one interest—the

state, a very important consideration. The statistical data, though incomplete in some respects, were representative of uniform conditions.

Let us contrast with this the extremely complex situation existing here. In the first place, our rate-making institution has been and still is a purely voluntary organization composed of at least four heterogeneous elements—stock companies, mutuals, state funds and insurance departments. Is it to be wondered at that competitive considerations, under these circumstances, are occasionally permitted to outweigh actuarial hypotheses, the soundness of which cannot be completely demonstrated. And how well it speaks for the scientific spirit which animated the work of the last conference if we consider that the participants were able to set aside their individual interests and work out rates by the best actuarial methods that could be developed with the scant material at hand.

Secondly, we have in our manual about 1,350 classifications as compared with 350 in Switzerland. This, as is well known, is a heritage of employers' liability insurance, and though cognizant that the legacy was not free from taint, the necessity for meeting the multitudinous other problems arising out of the rapid extension of compensation laws compelled us to accept it for the nonce. It might interest the members of the Society to learn that an informal conference which has been at work for the past year on regrouping, consolidation and elimination of manual classifications has recently completed its work and passed it on to the National Reference Committee for approval.

Finally, we have at least forty compensation states and as many different laws. At this late date no one will question the accepted principle that all of the available experience should be used in the establishment of basic rates. But since no two compensation states provide the same benefits, before the basic rates can be determined, the first problem, peculiarly our own, is to perfect the system of reducing the experience of the various states to a common level. Though I have the utmost faith in the ability of our actuaries, this problem in the very nature of it can be only approximately solved. Up to the present a single differential has been used in the reduction of losses. The use of partial or "sectional" differentials computed on the basis of the Standard Accident Table has been proposed. This may not meet the approbation of all as there is even now a strong contingent advocating the use of experience differentials. Suppose this particular problem has been worked out scientifically and to the satisfaction of all. Then arises the question of transforming the basic rates into state rates. Adopting the Swiss method, we determine the percentage distribution of the several elements of loss cost for each classification. We must now apply coefficients of transformation or sectional law differentials to each component of the loss in each classification, for each state separately. The immensity of this undertaking will be easily per-

ceived by any one who has had anything to do with the making of a manual. Even this objection might be waived. But practical considerations should make us hesitate to adopt this method. It will of necessity destroy the principle of the basic manual. Instead of one basic manual which is applicable to all states, insurance carriers will be compelled to issue a separate manual for each state. The slightest revision of a classification in whatever respect will require reprinting the page where it appears in each of the forty-odd manuals instead of one reprint for the basic manual. The resulting confusion and the excessive cost of printing and maintaining such manuals will have to be well considered.

It is extremely doubtful, moreover, whether the rates developed in this manner would be acceptable to all the states. We still have with us jurisdictions where the rate-supervising authorities adhere to the manual of rates established in the early days of compensation and who will permit of no modification except upon the evidence of experience accumulated in their own state, which in most cases is manifestly impossible. With them, actuarial science is hardly a criterion by which to judge the reasonableness or adequacy of rates, and no amount of actuarial theory or reasoning is likely to dislodge them from their attitude.

With this contrast before us, can it be reasonably expected that our compensation rate-making problems can be solved as readily as were those of Switzerland? Or that the use of similar methods will resolve them? I grant that the difficulties mentioned, though numerous, are not insurmountable. A great volume of experience is being accumulated involving an exposure of between eight and ten billion dollars. The Actuarial Section of the National Reference Committee should be able with this material to perfect the method of rate-making. And in this work the methods of the Swiss actuaries made known to us by Mr. Woodward will prove of signal aid.

MR. JOSEPH H. WOODWARD:

(AUTHOR'S REVIEW OF DISCUSSION.)

Mr. Flynn raised one or two points in his discussion which I think perhaps I can say something to further illuminate.

He spoke of the underwriting distinction made between the so-called small enterprises (namely, those employing ten or fewer workmen) and large enterprises. This distinction is illustrated by one or two concrete examples that I can give. Group 18 of the Swiss manual has the general description: "Small mechanical wood-working enterprises (up to ten workmen) without construction work." There are then several sub-classifications which come within the group. For example, sawmills, without accessory industries. The rate for degree of risk V, which is the average rate for small sawmills, is 100 francs per 1,000 francs payroll—equivalent

to our $10. The rate for degree of risk I, which represents the most favorable type of enterprise of this kind, is 50—which is one-half of the average; and the rate for degree of risk X, the highest rate quoted, is 140, about 40 per cent. higher than the average.

Turning to group 19 in the manual, the general description of the group is: "Large mechanical wood-working enterprises (with more than ten workmen) without construction work." There the average rate for sawmills is 70, which is thirty points under the average for small sawmills. For degree of risk I, which is the most favorable degree, the rate is 30 as compared with 50 for the small enterprise; for degree of risk X the rate is 110 as compared with 140. In general then, for wood-working enterprises, it is apparently the opinion of the Swiss actuaries that the rate should be higher for a small enterprise, disregarding all other considerations, and merely on account of its small size.

Mr. Flynn made the statement that he thought that probably it would appear, taking all things together, that the general results under the Swiss system and our system, after taking into account our schedule and experience rating, would not be so very different. Unfortunately, I did not give enough material in the paper to give a correct impression on this point. The probability appears to be that there is a considerably greater variation in rates among enterprises in a particular classification under this system than under our system in this country. Of course, I have no knowledge of the actual practice of the Swiss institution in applying these rates and actual practice is apt to differ from official promulgations. It may be that in operating a system of this kind there would be constant pressure to get risks rated under the superior degree of risk, and, consequently, there would be a good many more risks rated at the lower than the higher rates, so that the average rates would not be true averages. To offset that tendency, however, we should remember that the system is a monopolistic system; the effect of competition in business is not present, and the tendency would not be so great as it would be likely to be in this country.

Mr. Flynn also raised the question of the treatment of temporary cases—the adjustment of temporary cases. Again, I have no knowledge except from the deductions I was able to make from these publications as to what the actual practice may be, but apparently the general principle followed is to make the awards and adjust the claims for temporary cases that are under three years old substantially in the same way as we do and subject to review or revision at any time on request of the injured person, or at the instance of the insurance institution. After three years the rule provides that revision can only be had at the end of the sixth and ninth years, and from what I gathered, revised awards are compulsory at the end of six years and nine years. The cases come up automatically for scrutiny and revision at those times and at the end of nine years the award is made for life and not further disturbed.

Mr. Meltzer seems to think that the basic manual is endangered by some of the radical suggestions that are knocking about these days. Personally, I have felt for some time that the alleged advantages of the basic manual are to a considerable extent illusory and that there is no great objection to a separate manual for separate states in the sense that the rates in the manual need have no systematic mathematical relation from state to state. The advantage of such a relation is purely a matter of office convenience. While it is very important that there should be a complete uniformity of classifications between states, and every effort made to maintain it, yet so far as a uniform basis of rates between one state and another is concerned, my feeling is that in seeking such uniformity it is often impossible to avoid very considerable inequity between the various industries, and that equity should not be sacrificed to a slightly greater convenience in office methods. Where the payroll exposure in a classification is sufficient the rate for a particular state should reflect the experience in that state independent of the experience in other states.

NOTE ON THE CONSTRUCTION OF MORTALITY TABLES BY MEANS OF COMPOUND FREQUENCY CURVES—ARNE FISHER.

VOL. IV, PAGE 65.

WRITTEN DISCUSSION.

MR. EDWIN W. KOPF:

The general results achieved by Mr. Fisher in this paper are certainly as fascinating as any which have come from the laboratories of the modern analytic school in the physical and social sciences. Mr. Fisher's paper is in one sense a challenge. It calls for a statement of what sort of facts social statisticians are trying to discover, what limitations govern the use of such facts, and by what proper means we may bring data thus defined and circumscribed to bear upon the practical problems which face insurance science. Whether we work with the sense data of either the physical or the social sciences, we may agree, before we take up Mr. Fisher's paper in detail that there are four distinct categories of knowledge.

We have first the great mass of facts which we gain through direct observation, and this sort of data we term *empirical* knowledge. If we apply that process in the laws of thought which we call *induction,* by means of which we discover from observed facts the general principles or "law" respecting a given phenomenon, we arrive at the second category of our data, namely, *reasoned* or *generalized* knowledge. This reasoned or generalized knowledge oftentimes consists in bringing observed facts into accordance with others by means of certain reasonable assumptions or connecting hypotheses, which we hold to be acceptable and in accordance with sound common sense for such purposes. This second category of knowledge is perhaps the most advanced stage achieved by insurance and statistical science as we know it to-day. In fact, our known timidity in the employment of reasonable assumptions or hypotheses has on occasion resulted in that crude use of empirical data against which Mr. Fisher and a number of other analysts have so often protested in these *Proceedings.*

There is a third sort of knowledge, of which statisticians and actuaries have but rarely availed themselves—those statistical facts which may be *anticipated* by pure *deduction* from certain assumptions or hypotheses, subject to later verification by reference to empirical facts. The fourth and rather sublimated class of data which we could legitimately use in our everyday statistical work, had we the requisite courage for assumption, and the rigor of analysis, are

the facts which follow deductive analysis from hypotheses, but which are incapable of confirmation in the present feeble state of our technical resources.

Before considering the various elements of Mr. Fisher's paper, I shall ask you first to put away your impressions of the sufficiency or insufficiency of statistical data in the first category of knowledge, with its myriad forms, sheets, tables, pamphlets and volumes, and agree that instead of only one, or at most two, sorts or kinds of facts in insurance science, we may reasonably have four aids to understanding social phenomena.

Let us start off by saying that Mr. Fisher's note is an endeavor to contribute to the third category of legitimate knowledge in casualty and social insurance science, and that our criticism of the paper, if any, must be confined to testing whether Mr. Fisher has rigorously conformed to the criteria of this sort of knowledge or not. Our methods of criticism, which we usually apply to the facts and processes of the first two categories of data in insurance science, cannot help us very much in the present instance. Criticism in the third category of knowledge may be applied, first, to the hypothesis or hypotheses, and second, to the deductive processes, by means of which the several laws and conclusions are established.

Testing of Hypotheses in Insurance Science.

First, the hypotheses: The first few pages of Mr. Fisher's paper are a veritable network of hypotheses, some implied and some expressed, each one of which must be stated in the order in which it affects the entire groundwork of assumption which supports the deductive processes.

(*a.*) *The Implied Hypothesis as to the Nature of Social Statistical Facts. Does it Hold?*

There is first the implied hypothesis as to the *nature of the facts.* The statistical facts of social life are *developmental, dynamic,* or *genetic* in nature. They contrast with those data of the intensive method of research into laws governing particular insentient events or things, where the aim is to discover *constant* characteristics, regularities, recurrent forms, or *static* characters.

Data relating to social phenomena such as mortality, sickness, crime, poverty,—the functioning of society, etc., are developmental, dynamic—and are, therefore, so far as trustworthy observation informs us, decidedly variable, in respect to time, place and the constitution of the social group in which they arise. These phenomena have defied any well-considered effort to establish "types" apart from the severely limited circumstances which characterize a particular group. Professor Pearson in the lecture: "The Chances of Death," read before the Leeds Philosophical and Literary Society, January, 1895, asks us ". . . may we not assume that they (the

laws of frequency of apparently random sizes of things) are essentially the laws of all large numbers, and that even the frequency of death, its distribution by age, will obey the same laws?" The actual observation of deaths, with proper regard for special limiting conditions such as race, sex, occupational, age and other characteristics of populations, has shown all manner of departures from this assumption. The frequency of death, crime, and other social phenomena, is by no means of the same order of facts, i. e., as to whether of *dynamic* or *static* nature, as the frequencies recorded in coin-tossing, card-drawing, measuring fiddler-crabs or cephalic-indices of dolichocephalic German skulls.

Recall the reaction against the mathematical school of social philosophers, which began as far back as 1849. Quetelet had popularized Laplace and Fourier in considerable measure and had been in turn introduced to the English-speaking world through Sir John Herschel's efforts. In his treatise "Sur l'Homme et le Développement de ses Facultés, ou Essai de Physique Sociale," Quetelet had interpreted certain statistics of crime, suicide and disease as revealed by the data of the criminal courts and registration offices of France, The Netherlands and other countries to mean "... we shall be able to *fix* the laws to which Man has been subjected in different nations since their birth—that is to say, we shall be able to follow the centers of gravity of the (social) system." The influence of Laplace is evident throughout the work, especially when he speaks of the "stability of the social system" and compares the new science of society to the mechanics of the Heavens.* The philosophers Drobisch and Lotze first suggested, followed by Rehnisch, that this view was indeed premature, because of the disagreement between the requirements of sound hypothesis and the *nature* of such "knowledge" as: "Society, as it were, exacts a certain proportion of crime as it does of suicide, poverty, physical and mental disease." Mr. Fisher mentions, for instance, that Lexis had analyzed by means of his dispersion theory the extreme right part of the d_x curve of mortality as a "normal" curve with a maximum and mean in the neighborhood of age 70. Dispersion theory or no dispersion theory, Professor Pearson reports having applied this assumption to French data with but moderate success and to English statistics for males with complete failure. No hypothesis in social statistics has ever been proven in nearly a century of controversy to apply beyond the special group, limited to the time and place, to which it relates. The supreme and sufficient test of a hypothesis is whether or not it agrees with observed facts.

Mr. Fisher's first implied hypothesis is that the facts of mortality according to the causes of death are of such *static* nature that we may "analyze the series of deaths at various ages in a system of 8 (or 10) Laplacean-Charlier and Poisson-Charlier frequency curves, *typical* of distinctive groups of causes of death at various stages of life."

* Vol. II, p. 338, "Sur l'Homme, etc."

The lesson of all the eighty years of controversy and criticism of the school of social mechanics is that a supposition of *static* characters—*in material essentially dynamic* and variable according to time, place and social group—is contrary to observed facts. This objection holds, I believe, that the hypotheses underlying Mr. Fisher's deductive analysis are not general in application but must be, according to experience in social statistics, limited to groups of *similar sex, age structure, race and other constitution.* The apparently close agreement of Mr. Fisher's q_x values with those of Professor Glover is probably due to two factors: (1) the practically similar age constitution of males in the 1909–1911 data for the Original Registration States and in the 1910 data for the total Registration Area and (2) the correspondence of high values of $R_B(x)$ with high values of m_x and of low values of $R_B'(x)$ with low values of m_x for certain of the disease groups which weigh heavily in the entire experience. The form and other analytic characters of the curves for the several diseases and conditions may be typical so far as the general population of the registration area, males, of 1910 is concerned. The hypothesis is not sustained, however, by the facts of experience with similar endeavors of the mathematical school of social philosophers, when the attempt is made to employ it in constructing a mortality table for, say, locomotive engineers, textile operatives, males in Newark, New Jersey or in Boston, Massachusetts. The statistical parameters of the d_x column compiled from exposures and deaths for each of these groups may be expected from experience with similar situations in other subjects of social inquiry, to be essentially unlike.

I am not convinced that a mortality table can be constructed validly by means of compound frequency curves without complete reference to the social group to which it applies. I do believe, though, that when crude life table values have been prepared upon the basis of observed exposures and deaths, the compound frequency curve method can be justified as a powerful agent for graduation by sound hypotheses of special application to a particular social group only. Observe, for instance, the smooth character of Mr. Fisher's registration area curve in comparison with Professor Glover's values, graduated by a number of mechanical formulae.

(*b.*) *The Expressed Hypotheses.*

The other hypotheses forming the groundwork for the analytic procedure may be examined regardless of the lack of generality of the implied hypothesis as to the nature of the facts. I have not yet had the opportunity to test by practical calculation from data drawn from various social groups, whether the assumption holds that frequency curves of Types A and B are sufficient to represent the distribution of d_x values for the several diseases and conditions in a life table constructed according to conventional methods.

Limitation of such variable data to two type curves seems to be a somewhat Procrustean procedure. It may be, though, that the use of two types is a commonsense middle-of-the-road measure between a system of many types of curves and the single class of Pearsonian curves derived from the differential equation

$$\frac{1}{y}\cdot\frac{dy}{dx}=\frac{bx-x^2}{a-bx-cx^2},$$

where x represents the magnitude of a given deviation from the mean of a series of measures and y the frequency of such deviation.

Nor have I had the time to apply any tests to Mr. Fisher's grouping of the causes of death to form classes of deaths *typical* of youth, etc. There is a very considerable amount of labor attached to the trying-out process. Mr. Fisher assures me that the work is likely to provide good mental exercise before I discover just what causes of death he has merged in the several groups! Likewise the tests for "goodness of fit" and for errors due to sampling in the figures for locomotive engineers.

There is much in Mr. Fisher's paper that supports the plea for more contributions to the third sort of knowledge in insurance science—the knowledge based upon valid hypotheses, faithful analysis and final reference to actual experience. Results along this line in future will probably be as convincing as James Clerk-Maxwell's exhaustive statistical treatment of the kinetic theory of gases. Clerk-Maxwell's application of the theory of probabilities to the phenomena of gaseous substance placed upon a sound theoretical foundation the laws empirically established by Boyle, Gay-Lussac, Dalton and Avogadro. In insurance science we, too, may some day see harmony between the advocates of the first and third schools of knowledge—that harmony which comes of mutual understanding and helpful criticism.

MR. ALBERT H. MOWBRAY:

This paper presents a new method of constructing mortality tables from consideration of deaths only and causes of death. This proposal is indeed startling to most of us in view of our general training that a correct mortality table cannot be constructed without having regard to the exposures to risk, and we are confirmed in this view from our custom of comparing the deaths and exposures as the equivalent of the occurrences and possibilities of the probability fraction. The fact that it violates our present notions is, however, not valid ground for rejection of the method if it is not found unsound in theory and gives satisfactory results in practice. The fundamental hypothesis of the method is "that the numbers of deaths from specific causes cluster around certain definite ages in such a manner that the frequency distribution according to age from a specified cause or group of causes of death may be represented by a typical skew frequency curve."

Although it is not taken directly, it seems to me that indirectly through this hypothesis an hypothetical exposed to risk is set up from which the probability fraction is derived. Of course, the correctness or incorrectness of the theory hinges upon the truth of this hypothesis.

The examples worked out in Mr. Fisher's paper indicate that the method in skillful hands tends to produce satisfactory results and to the extent of the examples tried indicates the fundamental hypothesis is true. Before this is definitely accepted further practical tests of the hypothesis than those here presented will be necessary. For myself I may say that the fundamental hypothesis seems reasonable.

There are certain advantages which might result from the general adoption of the method here suggested for construction of mortality tables. The volume of data to be considered would be considerably reduced. This would facilitate the taking out of experience and probably speed the time in which the work could be done, as it would not be necessary to handle a large volume of cards relating to exposures which it is now necessary to handle. The method requires the analysis of the fatalities by cause and age, and it is my opinion that careful studies along these lines would be most helpful in increasing our knowledge and probably our ability to control disease. This analysis of cause of death especially in comparison with the elapsed time since the medical examination may throw a great deal of light on the mooted question of the duration of effect of medical selection. The method produces a mortality table that is already graduated and, therefore, the work of graduation it not added to the construction of the table and we avoid the possibility of distortion of results through the use of a graduation formula which may not be entirely suited to the data.

On the other hand the method presents certain difficulties which are by no means insignificant. In the first place it would appear that if cause of death is to be given the importance this method gives it in determination of mortality tables the diagnosis should be very accurate, and the statistical assembly should correspond to this accuracy of diagnosis. Equally careful mathematical analysis is also fundamental. Even upon the basis of these conditions it appears the method leaves a large amount of leeway for the personal equation in determining what causes shall be grouped together in the various frequency curves. It is true, as I understand it, that these curves will be subject to careful tests for stability, and yet, as Mr. Fisher points out, he, himself, is not entirely satisfied with the cause analysis he has made in this way. This cause analysis has been made where it has been possible to compare the material with carefully compiled mortality tables prepared by the methods heretofore used of comparing deaths with the exposures. After the particular frequency curves have been selected there is still some room for the influence of the personal equation in the

selection of constants, but the method of least squares, and other methods of mathematical analysis are probably sufficiently well developed to eliminate any pronounced error from this source. It may be that as we become better trained in the modern mathematical methods of statistical analysis we will be no more afraid of the personal equation affecting the application of this method than we are now of a like influence in graduation by the Makeham formula.

I sincerely hope that Mr. Fisher's method may receive careful consideration and adequate test through application to the construction of mortality tables in this country. Although it is a matter in which this Society is not concerned, it would seem that in the construction of the new mortality table now under way jointly by the Convention of Insurance Commissioners and the actuarial bodies of this country dealing with life insurance there would be an excellent opportunity to test out these methods.

I cannot but regret the implication of Mr. Fisher's remarks at the top of page 84. It may be that "Purely empirical methods . . . have been employed by far too great an extent by actuaries and statisticians." And it may also be true that this is "unfortunately at the loss of sound logic and commonsense reasoning." But human nature is human nature and when a man or a profession has made the best use of the tools it has hitherto had available, there is a very natural resentment at the use of such language when a new method is first put forward and when the profession has had no opportunity to make an adequate study of the new method. Perhaps the actuarial profession of America may be subject to some criticism for not having pursued its probability studies to the point where it has developed these methods, but if the profession is open to this indictment it at least has the defense that in the meantime it has built up on a sound foundation the present huge structure of American life insurance and extended its benefits to a vast number within our population.

MR. JOHN S. THOMPSON:

This recent paper of Mr. Fisher's concerning a proposed new method of analysis of mortality experience is an unusually interesting one and the mode of treatment is very suggestive, especially since the course described is a radical departure from that hitherto taken by actuaries when confronted with the problem of deriving a rate of mortality from a suitable experience.

In case of the treatment of the "Locomotive Engineers" experience there is satisfactory agreement between "actual" and "expected" deaths or between the "observed" and "calculated" deaths (frequency curve ordinates) as they are here called, so far as totals are concerned. Similar figures are not available for the work on the U. S. Life Tables, but the tabulated results indicate that the "fit" is equally good. So far as the distribution among

ages go the results cannot be said to be as good. For example, in case of the "Locomotive Engineers" experience, the two largest groups are C—D and H; in case of the latter the observed deaths are less than the calculated deaths up to age 39 inclusive, greater from 40 to 64 inclusive, and less thereafter. Under group C—D the observed deaths exceed the calculated deaths to age 49 inclusive and are less thereafter. Thus the most obvious test of a satisfactory graduation is not fulfilled but, of course, the extent of the series may be such that better results could not be expected. Indeed the percentage deviation is not great, being very little in excess of 1 per cent. in the total and there is no doubt that a high degree of statistical skill has been applied to the process described in the paper.

In brief, the method is to subdivide the totals of actual deaths classified by ages into corresponding groups by causes of death also classified by ages, the idea being that the subgroups can be more readily graduated by manageable types of frequency curves than can the whole series giving the deaths from all causes at successive ages. If we understand the process, therefore, the result is simply a graduation of d_x, the "actual" deaths, and it is not apparent why a mortality table should not be formed from the unadjusted deaths and some other function of graduation with equally good results. In other words, it is not clear what additional knowledge is furnished by subdividing the deaths by causes and how the excellence of statistical treatment compensates for lack of information covering "exposed to risk." Every actuary is familiar with the unfavorable, not to say disastrous results following upon the attempt to construct the Northampton Table from the record of deaths only. It is conceivable that the numbers of deaths either in total or by separate causes may be the same in two distributions when the "exposed to risk" are different. It is also certain that the rate of mortality in a stationary population is different from that in one in connection with which there is a regular net increment or decrement annually because of migration if the deaths are the same. If there is close adherence between rates of mortality deduced in the ordinary way and those deduced in the proposed way, it can only be because the net variation of the distribution from the stationary condition is not great. Moreover, the high rates of mortality at the very young and very old ages will, as usual, present greater difficulties of treatment because a given rate of variation in the exposures will produce a greater absolute variation in the deduced rate of mortality than at intermediate ages.

Statements regarding "Cause of Death" are considerably affected by errors arising from either (1) looseness of nomenclature, that is, the use of general instead of specific terms, confusion between immediate and contributory causes, etc., or (2) incorrect diagnoses. The execution of the physician's certificate as part of the proof of death may be carried out hurriedly or without the ex-

ercise of the usual professional exactitude and without the realization of the statistical value of the statement. The error, if any, results in the transfer of deaths from one class to another and if the net movement is not great the result or deduced rates will, of course, not be great. But it is reasonable to suppose that the rate of mortality based on the fact of death and the fact of exposure must be less affected by error than a calculation based on the cause of death, changes due to misstatement of ages, to statistical treatment and to the exercise of judgment arising in both.

The process described offers an excellent means of studying the mortality from a given disease or group of diseases (the deaths being more or less subdivided according to the requirements), provided the assumed frequency curve can be made to fit and the exposures can be obtained. There is no doubt that co-operation between the medical director and the actuarial statistician will result in a broader understanding of the incidence and destructive effect of various types of disease.

MR. CHARLES W. JACKSON:

Mr. Fisher's paper is very interesting and the method proposed by him a novel one and a wide departure from the methods customarily pursued by actuaries.

Before accepting Mr. Fisher's hypothesis, however, it will be necessary to submit it to many more tests than those to which it has been subjected at present. While the examples which are given in the paper appear to bear out the truth of the theory, I do not think they are sufficient to justify us in accepting it as established. We know that in the past, many an ingenious hypothesis has appeared to account for various observed facts, only to be overthrown and discredited later.

As stated above, it will be necessary to test it on several experiences, but here practical difficulties arise. Mr. Fisher on page 67 divided the experience into eight typical groups, namely:

B: Deaths typical of youth,
C: Deaths from industrial accident,
D: Deaths from pulmonary tuberculosis, etc.,
E: Deaths typical of middle life,
F: Deaths typical of late middle life,
G: Deaths typical of early old age,
H: Deaths typical of middle old age,
I: Deaths typical of extreme old age.

In the latter portion of the paper, he increases the number of the groups to ten and thus obtains better results. The author has not furnished us with sufficient data to test out his hypothesis on other experiences, for I do not think that any two men would agree as to the deaths which properly belong to groups E, F and G.

Mr. Fisher would be rendering a valuable service to the members

if he would go into greater detail and enumerate more specifically the nature of the different groups. Unless this is done, it is practically impossible to test the truth of the hypothesis, for the time required would be prohibitive.

In constructing tables based upon similar methods, Mr. Pedersen, I believe, made use of four groups; Mr. Pearson of five; Mr. Fisher of eight and later of ten. The question naturally arises whether the last number is sufficient and if it may not prove necessary to increase the number of groups still more.

It would be of great value to all of us to know whether the hypothesis is true or not, for if mortality tables can be constructed from the record of deaths alone, an immense amount of time can be saved, for in the investigation of any mortality experience, by far the greater part of the time of the clerical force is used in calculating the exposed to risk. If we can avoid this labor, a great saving will be effected.

We are greatly indebted to Mr. Fisher for his very interesting paper, which in my opinion would be much more valuable if it contained more detail.

MR. ARNE FISHER:

(AUTHOR'S REVIEW OF DISCUSSION.)

The remarks on my little note by the recent speakers are a striking illustration of the back-wash of a fierce conflict between two different currents of philosophical thought and, scientific method, the battle between the empirical and rationalistic schools of philosophy, represented by the Scotch and English philosophers, as Berkeley, Locke and Hume on the one hand and the continental philosophers, Descartes and Leibnitz on the other hand.

The empiricists maintained that all our knowledge is derived from experience, the rationalists claimed that in addition to what we know by experience, there are "innate ideas" or principles which we know independently of experience. The empiricists denied moreover the existence of logical principles independent of experience. After many years of thought this denial and probably the most important point of the controversy between the two schools has proven to be false, and it has been established that the rationalists were in the right. On the other hand, the empiricists were right in maintaining that nothing can be known to exist except by the help of experience.

Emmanual Kant and Herbert Spencer have attempted to reconcile the two views, and the methods of modern science and scientific research have to a certain extent effected a compromise between the two schools, although somewhat favoring the rationalists. The absolute impossibility to derive the corpus of human knowledge from mere empirical data and observations has been so ably demonstrated that no further proof is required on this particular

point. Yet many of our actuaries of the present day, especially of the Scotch school, seem still to believe in the fallacy perpetrated by John Stuart Mill in his attempt to found a "new logic" and to establish the law of causailty by what he himself termed "an inductio per simplicem enumerationem." This is blind empiricism, almost as narrow in its scope as that of St. Thomas, the apostle, who only would acknowledge the existence of things through immediate sensations. Bias of this or similar character is not uncommon among most Scotch collectors of statistical data, such as actuaries and medical men. I need only to refer to a recent statement of Professor Karl Pearson who informs us how he once pointed out to a Scotch actuary or statistician his prejudice in favor of whole centimeters relating to a series of measurements of human anatomy. The Scot looked at the results he had collected, recognized the bias, and then gravely told Mr. Pearson that it was not due to any personal bias, but that the creator must have designed Scotsmen on the metric scale. It is such paradoxes—more or less due to picayune empiricism—that makes the individual Scot or Irishman so dear to our heart and a source and veritable fountain of wit and humor, but also at the same time tends to make a collection of such individual characters unduly clannish. Every clansman, I am sure, is essentially an empiricist.

In total opposition to our Scotch friends stands the typical German. Most of us have wondered at the often queer antics of the German mind. These antics I feel sure are the outcome of a consistent and stubborn rationalism, ignoring experience. German logic in itself, as a mere formal logic apart from psychological logic, is keen enough, but it is in most cases founded upon a completely wrong hypothesis. In spite of this shortcoming the extreme rationalism of the German mind has in this war proven a tremendous power, although a power for evil only. Happily most normal individuals such as Americans, Englishmen, Frenchmen, Latins and Scandinavians occupy a position between the two extremes of the Scot actuary and German pedagogue.

The philosophical model of modern scientific thought and research work is characteristic of what Jevons called a complete process of induction consisting of four stages, viz., *observation, hypothesis, deduction* and *verification.*

The distinguishsd Italian physician and philosophical critic, Enrico Marselli, has crystallized the content of the philosophy of science in the following extracts taken from the introduction to his "Review of Scientific Philosophy."

"We think the moment has come for professional philosophers to allow themselves to be convinced that the progress of physical and biological sciences has profoundly changed the tendencies of philosophy; so that it is no longer an assemblage of speculative systems, but rather the synthesis of partial scientific doctrines, the expression of the highest general truths, derived *solely* and *imme-*

diately from the study of facts. On the other hand, we hope also that in every student of the separate sciences whether pure or applied, the intimate conviction will take root that no science which applies the method of observation and experiment to the particular class of phenomena which form its subject, can call itself fully developed so long as it is limited to the collection and classification of facts. Scientific dillettantism of this sort must end by sterilizing the human mind, whose natural tendency is to advance from observed phenomena by successive stages to the investigation of their partial laws and from these to the research of more and general truths. But philosophy thus understood, can never confine itself with the dogmatism of a system but rather will leave the individual mind free to make constant new concessions, in the pursuit of the truth."

The same ideas are expressed in even more trenchant form by another Italian, Federigo Enriques, in his "Problemi della Sciensa" ("Problems in Science") as follows:

"To-day they claim that by reasoning we can penetrate the secrets of the universe, which should be mysteriously revealed in the laws of the mind is banished as a chimera. But on the other hand we see that all observations and experiments are of scientific value only so far as they are supported by a reasoning process. Otherwise we should be obliged to wait until nature should be so obliging as to teach us, by answering at random these questions which we should neither know how to ask nor to interpret."

"Watchful waiting" may have its value in diplomacy and politics, but it has no place in science. The whole history of science from the dawn of antiquity to our present day has proven that the human mind is aggressive and does not wait patiently on being taught by experience but hastens ahead with its hypothesis and methods.

But have the so-called "actuarial science" and actuaries in general not exactly adopted such a policy of watchful waiting?

Many people are in the habit to look upon an actuary as a mathematical wizard, a sort of little deity, or oracle, whose authority is unquestioned. For a number of years I held this view myself, but so far as I can judge from recent contributions to assurance mathematics and assurance statistics I feel that most actuaries have been completely dominated by narrow empiricism and that their rather slavish adherence to certain patterned methods of gathering and cataloguing facts have probably had the effect of what Morselli called the sterilization of the mind. As a rather youthful and so to say unknown quantity in statistical and actuarial circles I fully realize that such a sweeping assertion in respect to a body of eminent men can not stand on its face value unless it is supported by historical evidence, which I now shall endeavor to bring forth.

The name of the celebrated Edmund Halley, Astronomer Royal of England, is remembered for two achievements which he was the

first to accomplish: the computation of a comet's orbit and the construction of the first mortality table. Halley thus represented and actually founded one of two at his time essentially empirical branches of human knowledge, astronomy and actuarial methods, none of which at that time (about 1690) could lay claim to the title of a part of science. It is of interest to see how the development of these two branches has been since the time of Halley and how their respective progress compare at the present time.

The originator of the Breslau Life Table was a contemporary of the great Newton who through the development of that particular part of mathematical analysis, known as the infinitesimal calculus, discovered the key that opened the doors for the exploration of the sciences of astronomy and physics and actually became the mathematical foundation of these two sciences.

The genius of Newton was far seeing enough to break with the traditional views of mere empiricism then reigning in astronomy and physics. Like a true rationalist, perhaps the finest type of positive rationalism in the whole history of mankind, he hastened ahead with hypotheses and opened new fields of investigation for the astronomers and physicists. His fertile genius left the sterilized minds of the empirical observers to make additional observations and to gather further data. What was the result? A tremendous development of astronomical and physical sciences. Gallic genius under the leadership of Lagrange, D'Alembert, Legendre, Cauchy, and especially Laplace, took up the heritage of the great Englishman and perfected the splendid structure to which he had laid the foundation. The genius of Laplace is fully equal to that of Newton and shows again the superiority of fertile rationalism over sterile empiricism. In the "Mechanique Celeste" the riddle of the stellar bodies was laid bare by the methods of a rationalistic mind and the empiricist had only to verify by additional observations the results which Laplace had deduced by a mathematical analysis. Astronomy is to-day, thanks to Laplace, one of the most perfect among the exact sciences. It has torn itself away from the clutches of empiricism, which now is its servant instead of its master.

Such has been the development of astronomical and physical sciences since the time of Halley. From mere empirical methods they were elevated to a theory by Newton and perfected into exact sciences by the French mathematicians. Can the same be said to be the case with the actuarial methods as introduced by Halley? I am well aware of the fact that most actuaries are in the habit of speaking of "actuarial science." So false and misleading is this name that even those who more modestly speak of "actuarial theory" are wrong, since all what actuaries can justly speak of are actuarial methods, purely empirical in their conception and application. The mentioning of actuarial science and even of actuarial theory must at the present state of development be regarded as mere phrases.

Have the principles as introduced by Halley in the study of mortality essentially changed from their purely empirical character? I fear I will have to answer this question in the negative. Dr. Milne in the construction of the Carlisle Table took into account the exposed to risk, which were unknown to Halley, but otherwise his method was almost identical to that of Halley. Since the time of Milne a number of ways have been devised to graduate the irregularities of the crude observed data. I can mention you at least twenty-five interpolation or summation formulas used in graduation, and all of which really are special cases of the general Newtonian Interpolation Formula.

Gompertz's and Makeham's hypothesis constitute an attempt to base the investigations on human mortality on a more scientific basis, but unfortunately the Makeham formula can at its best only be called a successful graduation formula.

Let us briefly consider the fundamental features of constructing a mortality table by means of the usual actuarial methods. A certain number, say l_x, persons at age x, are kept under observation for a full calendar year and the number d_x who die among the original l_x entrants during the same year are recorded. The ratio $d_x \div l_x$, is then considered as the crude probability of dying at age x. Similar crude rates are then obtained for all other ages. These crude rates are then subjected to a more or less empirical process of graduation to smoothen out the observed irregularities arising from random sampling. One then chooses an arbitrary radix, say 100,000 persons at age 10, which represents the original cohort of 10-year-old children entering under our observation. This radix is now multiplied by the previously constructed value of q_{10}, and the product represents the number dying at age 10. This number, d_{10}, is subtracted from 10,000 and the difference is the number living at age 11, or l_{11}. This latter number is then multiplied by q_{11} and the result is d_{11}, or the number dying at the age of 11 out of the original cohort of 10,000. In this way one continues for all ages up to 105 or so. The d_x column—or the compound frequency curve—is thus an auxiliary column, a mere by-product of the empirically determined q_x.

Allow me to ask you a simple question. Do these empirically derived numbers of deaths at various ages out of an original cohort of 10,000 entrants at age 10 give us any insight or clue as to the exact nature of the biological phenomenon known as death, and are we by this method enabled to lift the veil and trace the numerous causes which must have been at work and served to produce the total effect, the d_x curve, of which we through the usual conventional methods have a purely empirical representation?

I fear we will have to answer this question in the negative. The usual actuarial methods do not give us a single glance into the relation between cause and effect, which after all is the ultimate object of investigation for all real sciences. Probably many of

my critics would answer that they are not interested in investigating causal relations. An ignoring attitude like this is, however, very dangerous for a statistician, whose very work rests upon the validity of the law of causality.

We shall, however, overlook this evident inconsistency of the empiricists and instead turn our attention to such methods as a rationalistic positivist would employ were he to construct a mortality table.

Such methods we should find to be completely reversed to those of the empiricists, both in respect to points of attack and deduction. In the case of the empiricist the q_x is the initial fundamental function from which the d_x column is computed as a mere by-product. The rationalistic method starts with the d_x column and winds up with the q_x column as a by-product.

The positivist investigator is thus primarily interested in the absolute number of deaths and not in the relative frequencies of deaths at various ages. His very first question is therefore: What is the form of the curve representing the deaths at various ages among the survivors of the original cohort of 10,000? Right here we can, strange to say, apply some purely a priori knowledge. We know a priori that the curve must be finite in extent and assumes only positive values. There can be no negative numbers of deaths unless you were to regard the reported theological miracles of resurrections from the Jewish-Christian religion as such. This information is, however, not sufficient to use as a basis for a purely deductive analysis. We must, therefore, look about for additional information whether of an a priori or an a posteriori character and of such a *general character that it can be adopted as a hypothesis.*

As Poincare once said, every generalization is a hypothesis. Hence we shall look for some *general* characteristics which *all* mortality tables have in common in the age interval under consideration (age 10 and upwards). Now if you take any mortality table, I do not care from what part of the world, you will notice that the numbers of deaths in the d_x column gradually increase from age 10 and until a certain maximum or high crest is reached. After that the numbers begin to decrease quite rapidly, until at age 100 or so only a few numbers are found among the deaths. This high crest with its subsequent rapid decline is found in all existing mortality tables. It does of course appear at various age periods for various localities and populations. In India the high crest for male lives occurs at the age period, 45–50, among most of the Aryan races it falls around the age of 70. The main fact is, however, that this crest is a general characteristic of all mortality tables. We can, therefore, see that the d_x curve is a single valued, positive function with at least one maximum value gradually diminishing towards youth and old age. Such a curve has all the properties of a frequency curve which—as proven by Charlier and Jörgensen—can be represented as the sum of Laplacean-Charlier and Poisson-Charlier

frequency curves of types A and B. So far we have been on perfectly firm ground. We know positively the compound curve is composed of A and B curves. But how shall we construct these separate component curves? No a priori reason will guide us so we must resort to a hypothesis. Now each cause or group of causes of deaths has certain typical characteristics as to its occurrences in various age periods of life. We know for instance that there is a much greater probability that a boy of 5 years will die from measles than that an 85-year-old man will die from measles. On the other hand there is quite a large probability that an 85-year-old man will die from diseases of the prostate gland, while such an occurrence is almost unheard of among younger ages. Similarly deaths from cancer and Bright's disease are very rare in youth but quite frequent in older ages.

Now since we know that the d_x curve is composed of A and B curves and that the probability of death from certain diseases are typical of various age groups it lies close at hand to adopt as a hypothesis that the distribution of deaths from certain causes among the survivors at various ages of the original cohort can be represented by A or B curves. I do not need to state here why such curves necessarily must be skew in appearance as far as the clustering tendency around the mean value is concerned.

The hypothesis does not imply that the curves are fixed or static. Mathematical statistical methods are essentially methods devised to study the dynamic changes in life where a rigid state as known from the theory of static bodies does not exist. Without doubt the curves would group themselves around different ages, in the tables for India than in Europe or America. I have, however, found that a number of statistical data relating to causes of death may be represented by the system of ten curves as given in the examples in the paper, especially in view of the fact that I by this time have obtained better equations for the older age curves.* I have constructed male life tables for England and Wales, Newark, Boston, Detroit and Copenhagen. The English table is especially instructive because we have here a complete registration in the whole country for the years of 1911 and 1912 for which the table was constructed. Moreover, we are able to compare the table thus formed with the table known as English Life Table, No. 8, as constructed

*Another improvement is that the parameters as originally computed have been corrected by means of the "Sheppard Correction Formula," thus allowing for errors of grouping in 5 year intervals. Moreover, it was discovered that there among the deaths in the younger age periods, say up to the age of 50, among the Locomotive Engineers were included a number of permanent disabilities from blindness and amputations of legs and arms. The mortality rate is therefore too high in the younger ages and middle life. A monograph on the mortality among Locomotive Engineers is at present being prepared by Mr. F. S. Crum and will contain the new and corrected frequency curves.

by Mr. King by the usual methods from the deaths by age and the exposed to risk at the same age. The close agreement between the values of q_x is shown in the following table and diagram.

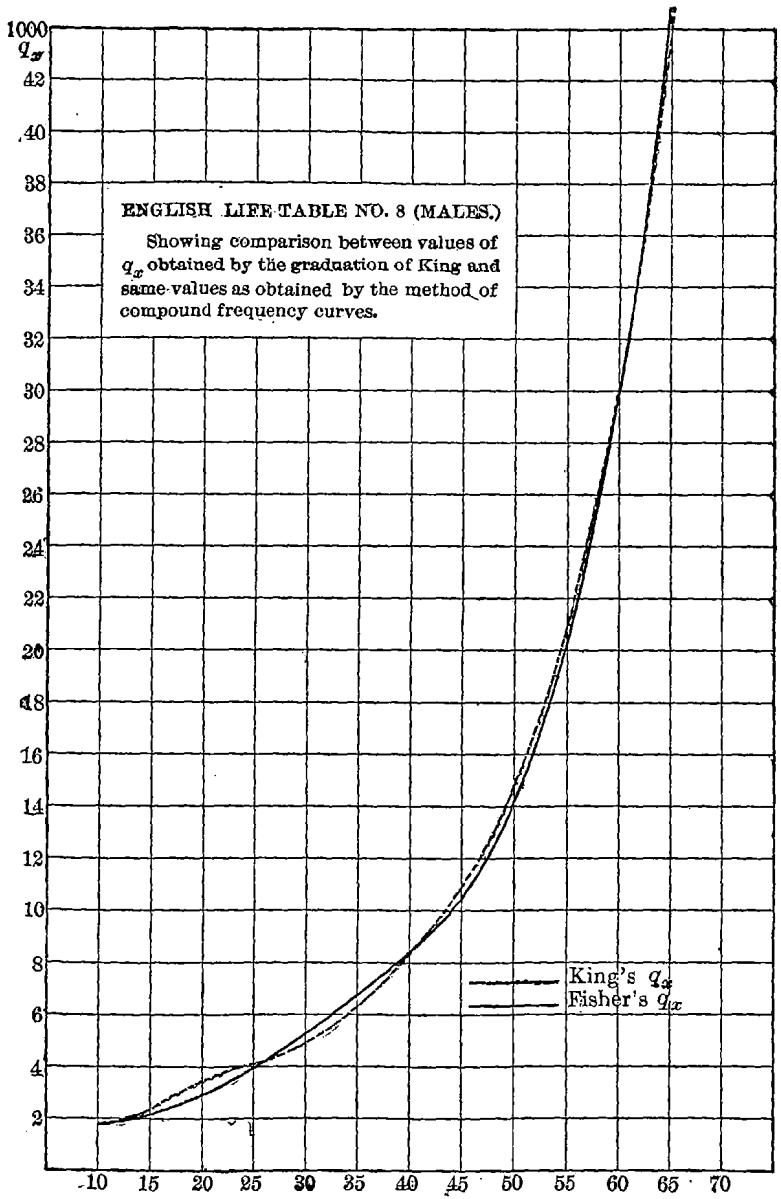


TABLE I.

Comparison between values of 1,000 q_x of English Life Table No. 8 (Males) as constructed by Mr. George King's method of graduation and corresponding values of q_x as computed by Mr. Arne Fisher's method, of compound frequency curves from the mortuary records by age, cause of death and sex of the Register General for England and Wales 1911–1912.

Age.	King's 1,000 q_x.	Fisher's 1,000 q_x
10	1.93	1.79
15	2.35	1.99
20	3.48	2.98
25	3.99	3.93
30	4.78	5.34
35	6.24	6.82
40	8.11	8.41
45	10.89	10.50
50	14.82	14.08
55	21.11	20.41
60	30.42	30.64
65	43.75	44.75
70	64.70	63.08
75	97.51	90.52
80	142.99	133.33
85	199.11	187.95
90	273.95	238.01
95	315.64	348.38
100	416.04	386.84

On the other hand, the data from New York City completely defy any attempt to use the system of ten curves. This is due to a certain reason and a very interesting one indeed, but one which I shall not discuss at this moment.

The successful construction of a mortality table from the absolutely independent material from England and Wales apparently disposes of the criticisms of Mr. Kopf as to the influence of the age distribution of the exposed to risk. This latter distribution is namely quite different in England than in the United States where emigration of younger members makes itself strongly felt. Moreover Mr. Kopf seems to be totally ignorant of the origin and generation of compound frequency curves when he makes the following remark:

"The frequency of death, crime, and other social phenomena, is by no means of the same order of facts, *i. e.*, as to whether of *dynamic* or *static* nature, as the frequencies recorded in coin tossing, card drawing, measuring fiddler crabs or cephalic—indices of dolichocephalic German skulls."

Leaving the German skulls to be taken care of by the bombing squadrons of the Allied airmen and aviators, the first part of this

statement is absolutely erroneous. In regard to the distinction between static and dynamic facts on which Mr. Kopf bestows such great care, I simply wish to state that in all statistical records a static state is unknown. All statisticians deal with variation and the mathematical relation of variates, hence their methods must bear a close relation to the methods of mathematical dynamics. Again, if Mr. Kopf will go to the trouble to investigate the frequency distribution of the frontal breadths of the crab, *Carcinus mœnas,* as measured by Weldon and subsequently analyzed by Pearson as a compound frequency curve with two normal components, he will find that this compound frequency curve is almost identical with the d_x curve of the mortality table. So far as coin tossings or card drawings are concerned I can assure Mr. Kopf that I, from records of such tossings or drawings, can produce a compound frequency curve of exactly the same form as a graduated d_x curve of any mortality table, if he will be obliging enough to make a million individual drawings of cards or differently colored balls from separate urns, such drawings being properly arranged in 8 or 10 sets of simple Lexian series with varying probability from set to set. Taken as a whole, Mr. Kopf's remarks seem to me nothing more than mere verbalisms and vague generalities. I therefore probably might be pardoned for saying that Mr. Kopf's beliefs and doubts are not my reasons.

Let me in conclusion say this: I am a believer in rationalistic positivism in all questions of science and although I by no means wish to underestimate the value of purely negative criticism, I, as a rule, only use criticism in its positive sense.

I fear that the so-called actuarial science of the late years has reached a state of stagnation. The attitude of "watchful waiting" I spoke of before has from a mere habit become a real menace. Mechanical aids of various kinds such as Hollerith and Powers tabulators have so facilitated the mere arithmetical processes of collections and tabulations that we do not need so much as before the introduction of new methods to eliminate the excessive arithmetical work of the old days. This mechanical aid has, however, so dulled the brains of many of our actuaries that they often work as mere mechanical adjuncts of the Hollerith machines, a sort of a superior kind of routine sorter. The mind of man is, however, too worthy a product of progressive evolution that it should be relegated to such a routine state of bookkeeping and calculating. Human thought was by its power of reasoning among the old Greeks justly considered as a divine gift. The ability of man to produce various hypotheses has widened the realm of science and brought modern research away from narrow empiricism. Who among you will deny the power of deductive reasoning as based upon hypothesis when it has the power to arouse debate, when it instigates the utilization of collected statistics which hitherto have been of little value and emphasizes new distinctions of facts, whose objective value, although not impeachable, make us view certain phenomena in a new light?

SOME ESSENTIALS OF SICKNESS STATISTICS—EDWIN W. KOPF.

VOL. IV, PAGE 107.

WRITTEN DISCUSSION.

MR. ALBERT H. MOWBRAY:

This is the first part of a chapter in a text-book which will prove a very valuable manual for students of casualty and social insurance. This part deals with the statistical *description* of sickness, or the collection, editing and tabulation of crude data as distinguished from the critical analysis of tabulated material. The paper in itself will be valuable not only for its own suggestions, but for copious references to the works of others. The writer seems to have taken two propositions as his text, one of which appears in the second paragraph of the paper, "We, in America, must insist upon an impartial thorough search for the facts of sickness if we would build a durable insurance and public health structure," and the other at the top of page 122, "The aim of sickness statistics should be the accurate extensive portrayal of sickness in its fourfold aspects."

The writer does not make it entirely clear what he means by the fourfold aspects of sickness, but it would appear that he has in mind his remark on the preceding page, "Most cases of serious sickness require (*a*) medical, nursing or surgical attention, (*b*) convalescent or after care, (*c*) solution of a social problem, i. e., stresses such as acute or chronic poverty, undesirable home conditions (bad housing, delinquency, or other illness in the home), industrial superannuation, or other situations exist which make for recurrence of illness or retardation of recovery, and (*d*) education of the patient, of members of the family and of the community in the prevention of further sickness." This certainly makes a heavy requisition for social work upon sickness statistics.

It will be noted that the treatment is from a broader viewpoint than most of the papers appearing in our *Proceedings* in that the writer does not confine himself to the insurance aspects of his problem, but also considers sickness statistics as the basis of a public health structure. He has, therefore, brought under review sickness data which only more or less indirectly bear upon the problems of sickness insurance.

The paper discusses the source of data under two general headings

1. General Population Experience,
2. Experience of Special Groups in the Population.

It may be some shock to those of us connected with insurance institutions to note that the place of accident and health companies does not come until subdivision (*c*) of the second group. Besides outlining the general sources of data the writer discusses the best methods of working from each source, including the requirements in order that the best possible data may be obtained. He also takes some notice of the use to which the results may be put. Although within the limits of a paper in the *Proceedings* of this Society it is only possible to discuss briefly many topics about which it is possible to write extensively, the whole field of statistics of sickness seems to be broadly covered in the paper.

Turning to the details, the writer's definition of sickness beginning at the bottom of page 110 seems strikingly broad since it would include "any objectively or subjectively apparent abnormality," either of structure or function of the body or any of its parts, including the brain. No limitation is placed upon the abnormality, and a strict logical following out of the definition might include all cases of unusual genius as cases of sickness! Even leaving out such absurd extensions of the definition, I question whether in his desire for an all-inclusive definition Mr. Kopf has not gone a little too far. In the next paragraph, however, he further limits himself and indicates that for practical purposes statistical consideration of sickness must be limited to what might be termed, although he does not so refer to it, "sickness disability."

On pages 113 and 114 Mr. Kopf sets out very clearly the terminology used in his paper, which seems well adapted to distinguish the various rates deduced from sickness data which, as I understand it, are generally being adopted. Uniformity in this regard is highly desirable as leading to clearness in discussion.

Mr. Kopf lays down on page 116 certain definite principles to be observed in sickness census practice, and the second of these is: "The facts must be recorded only for whole families who express willingness to impart the necessary information."

This principle is laid down because "Compulsion will probably yield no results." The query naturally arises whether there is not thus produced selection which will have some tendency to distort the results. The selection may be unavoidable, but if the rates are to be used as the basis of any financial computations its presence should be known and recognized.

The writer seems to be a bit unfortunate in the presentation of the third point in the summary of the results of sickness inquiries by the census method. In fact there appears to be a contradiction between his statement that sickness rates developed are at a maximum if the enumeration is made in the spring, and his statement that the resulting figures should be qualified as a conservative estimate of at least the average number of days lost per person. If the preparation of the textbook of which this is to be a part has not proceeded too far, it might be advisable to make some slight alteration in the presentation of this point.

In view of the agitation for general sickness insurance legislation in this country, the enumeration on page 125 of the variant factors found in insurance experience is highly interesting and important. In an earlier paper before this Society (*Proceedings*, Vol. III, p. 213) the writer attempted to make some comparisons between the relative effect of three of these, not with a feeling that these three were the only important variants, but rather because suggestions as to organization indicated that even these important variants were not having the careful consideration to which they were probably entitled.

In closing his paper Mr. Kopf alludes to the problem in sickness insurance which is an ever-present problem in all statistical work where comparison between different investigations is of importance, namely, the problem of nomenclature. Fortunately the variations in this regard in different jurisdictions are not as wide as they are in certain other lines of statistical work. In closing Mr. Kopf suggests that he hopes to present in a later paper a treatment of the second part of the general subject of sickness insurance statistics, namely, "Graduation and Higher Critical Analysis of Tabulated Data." We may certainly look forward to some very interesting material being presented to us in that paper.

MR. EDWIN W. KOPF:

(AUTHOR'S REVIEW OF DISCUSSION.)

Somewhere between the perhaps too broad treatment which I gave this introductory essay on the elements of descriptive sickness statistics and the hasty summaries of sickness "statistics" which are served to us in some health insurance discussions, lies the happy mean. As to the necessary breadth of discussion, may I not suggest that our statistical study as well as our social legislation be guided in future more than it has been in the past by the spirit which actuated British Liberalism of the nineteenth century?—the spirit which gave us the Friendly Society and Cooperative movement and the social legislation sponsored by Anthony Ashley-Cooper. Broad in its application to many phases of a single problem; but deep in its hold upon abiding facts. The present world-struggle between the Tory-Junker, with his static, anachronistic view of human life and destiny, and the Liberal with his well-grounded dynamic faith in the self-reliant common man, should lead us to revise what we have thought essential in social data and in social legislation. Would the liberal viewpoint comprise nearly all the statistical data on sickness in order to determine whether we know much about sickness socially or not, or would it center upon sickness only as an insurable incident? Are we so certain that we really know sickness even in its subordinate economic aspects as to say with one of our members: "The value of an investigation of

the cost of a health insurance system in . . . . would be to tell you whether your cost would be 3⅗ per cent. of wages, or 3⅞ per cent. or 4⅒ per cent. You may be sure in advance that your cost will be between 3 and 4½ per cent., probably about 3⅓ per cent." Why this tendency toward the static and dogmatic in social statistics? We need a statistical Declaration of Independence from two vain notions: First, from the all-sufficiency and stability of collected sickness insurance data, especially the German figures, and second, from the Tory policies, reactions and phrase-mouthing at the foundation of German social-welfare insurance. Whatever we may do in America in applying the principles of insurance science to the facts of sickness, should be founded upon broad and impartial study and upon social policies in conformity to those essentials of British and other Liberalism which will eventually triumph in this present War against dynastic, entrenched Toryism of the Potsdam variety.

Mr. Mowbray's point as to selection in family statistics of sickness: The data of sickness censuses of families willing to supply data will always be subject to qualification, as mentioned by Mr. Mowbray. But they supply information on another important issue not discussed in the essay; family sickness statistics show how seriously the functioning of the wage-earner's family is disturbed and to what extent a plan of insurance serves to sustain the institution of the family under the shock of serious or disabling illness. Workmen's insurance problems are very largely family problems. The selective nature of census family statistics of sickness is perhaps more than compensated by the use of such statistics in the study of the social utility of wage-earners' insurance.

The phrase "of at least the average number of days per person" should read "of at *most* that average number of days per person."

CURRENT NOTES.

Statistics of Sickness in American Industry.

A Committee of the Industrial Hygiene Section, American Public Health Association, is planning the collective study of the statistics of absences in industry due to sickness. A standard form has been drafted, and will be offered to various leading industrial groups for adoption. The resulting statistics of disability from sickness (excluding industrial accidents) will be of decided interest to students of health insurance and allied matters.

Legal Notes in the Proceedings.

The Council of the Society has authorized the publication of Legal Notes, to be written by Mr. Richard Fondiller. These will comprise a digest of important decisions of interest to the profession, handed down by the courts of last resort in all the jurisdictions in the United States. Legal Notes, which appear for the first time in this number of the *Proceedings,* will cover all the casualty lines.

Instruction in Statistics Available to Students of the Society.

The following courses in statistics will be opened to students, according to present plans, during the 1918–1919 college year:

Yale University. School of Medicine, Department of Public Health.

A course in vital statistics, running throughout two semesters, Saturday afternoons. Given by Dr. Louis I. Dublin.

Johns Hopkins University. Department of Public Hygiene.

A course in elementary and advanced biometry, vital statistics and actuarial-mathematical methods in statistics. Given by Dr. Raymond Pearl.

New York University. School of Commerce, Accounts and Finance, Washington Square East, New York City.

A course in the elements of statistical method including population and vital statistics. Given by Dr. Roland P. Falkner.

Columbia University. Faculty of Political and Social Science. A course in two semesters. The first semester is devoted to the elements of statistical method and the second semester to practical laboratory work in statistics. Assistant Professor Robert E. Chaddock is in charge.

Extension of Statistical Work of National Workmen's Compensation Service Bureau.

It is interesting to note that steps are being taken by the Central Statistical Committee of the National Workmen's Compensation Service Bureau for an extension of their system of standardized statistical plans. The Bureau has already issued uniform plans for the compilation of workmen's compensation, automobile and general liability statistics. This year special committees are working on additional plans for teams and manufacturers' and contractors' public liability statistics. The new plans will probably be ready for use on January 1, 1919.

Extension of Basic Manual to Quebec.

The Eastern Casualty Underwriters' Association of Canada has adopted in principle the American rating system for workmen's compensation insurance in the Province of Quebec. It is proposed to adapt the Basic Manual to Quebec conditions and to introduce schedule and experience rating. The details of the plan are under investigation by a special committee and there is every indication that the change in rating methods will be accomplished within the near future.

Richard Fondiller has been appointed assistant actuary of the New York State Industrial Commission.

George Graham has been elected vice-president and actuary of the Missouri State Life Ins. Co.

William J. Graham has been elected third vice-president of the Equitable Life Assurance Society.

L. G. Hodgkins is the secretary of the Masonic Protective Association.

Arthur Hunter has been elected chief actuary of the New York Life Ins. Co.

William C. Johnson is the vice-president of the Masonic Protective Association.

Walter I. King is the superintendent of the group insurance department of the Connecticut General Life Insurance Company.

Mrs. Dorothy M. Rolph is the director of the compensation division of the War Risk Bureau.

Harwood E. Ryan is the actuary of the New York State Insurance Department.

Charles G. Smith is the actuary of the New York State Insurance Department.

William Young has been elected actuary of the New York Life Ins. Co.

Members are requested to send to the Editor items for publication under Current Notes.

RECENT LITERATURE ON CASUALTY AND SOCIAL INSURANCE.

PREPARED UNDER DIRECTION OF THE LIBRARIAN.*

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———

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b. *Health Insurance.*

AMERICAN ASSOCIATION FOR LABOR LEGISLATION.

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BEAL, J. H.

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C. Industrial Accidents, Diseases and Poisons.

1. *Accidents.*

Chaney, L. W., and Hanna, H. S.
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California.
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2. *Diseases and Poisons.*

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HAMILTON, ALICE.
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HOFFMAN, FREDERICK L.
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KOBER, GEORGE M., and HANSON, W. C.
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NEW YORK STATE DEPARTMENT OF LABOR.
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UNITED STATES.
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———

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D. MISCELLANEOUS, STATISTICS AND GENERAL THEORY.

BLAKE, C. S.
Steam Boiler Insurance: History and Future Prospects. (Convention year book 1916, pp. 107–112, 1916.)

BAILEY, W. B., and CUMMINGS, JOHN.
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GUILFOY, WM. H., and KOPF, EDWIN W.
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E. BIBLIOGRAPHICAL NOTES.

AMERICAN ACADEMY OF POLITICAL AND SOCIAL SCIENCES.
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NATIONAL CONFERENCE OF SOCIAL WORK.
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Proceedings of the Conference on Social Insurance called by the International Association of Industrial Accident Boards and Commissions, [Washington, D. C., 1916, Government Printing Office, 1917.] (1) Workmen's Compensation. (2) Sickness (Health) Benefits and Insurance. (3) Invalidity and Old Age Insurance. Pensions and Retirement Allowances. (4) Maternity Benefits and Mothers' Pensions. (5) Unemployment and Saving Bank Insurance.

THE CASUALTY ACTUARIAL AND STATISTICAL SOCIETY OF AMERICA.

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	GEORGE D. MOORE	October, 1918
	VIRGIL M. KIME	October, 1919
	WALTER I. KING	October, 1919

COMMITTEE ON ADMISSIONS.

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CHARLES G. SMITH

MEMBERSHIP OF THE SOCIETY, MAY 20, 1918.

FELLOWS.

Those marked (†) were Charter Members at date of organization, November 7, 1914.

Those marked (*) have been admitted as Fellows upon examination by the Society.

Those marked (§) are in the military or naval service of the United States.

Date Admitted	
†	§Amerine, W. M., Actuary, Georgia Casualty Co., Macon, Ga.
†	Archer, William C., Second Deputy Commissioner, State Industrial Commission, 230 Fifth Ave., New York.
†	Baldwin, F. Spencer, Manager, State Insurance Fund, 230 Fifth Ave., New York.
†	Benjamin, Roland, Comptroller, Fidelity & Deposit Co., Baltimore, Md.
†	Black, S. Bruce, Treasurer, Liberty Mutual Ins. Co., 185 Devonshire St., Boston, Mass.
Apr. 20, 1917	§Blanchard, Ralph H. Instructor in Insurance, 506 Journalism, Columbia University, New York. (Lieutenant.)
May 19, 1915	Bradshaw, Thomas, Commissioner of Finance and City Treasurer, Toronto, Canada.
†	Breiby, William, Office of Fackler & Fackler, Consulting Actuaries, 35 Nassau St., New York.
*Oct. 31, 1917	§Brockway, U. Hayden, Travelers Ins. Co., Hartford, Conn. (Lieutenant.)
†	Brodin, Richard, Actuary, United Life and Accident Ins. Co., Concord, N. H.
Oct. 22, 1915	Brown, Herbert D., Chief of U. S. Efficiency Bureau, Washington, D. C.
Oct. 22, 1915	Brown, William H., Secretary and Treasurer, Columbian National Life Ins. Co., Boston, Mass.
†	Buck, George B., Actuary, City of New York Commission on Pensions, Municipal Building, New York.
May 26, 1916	Bucklin, Walter S., President, Liberty Mutual Ins. Co., 185 Devonshire St., Boston, Mass.
†	Budlong, W. A., Superintendent of Claims, Commercial Travelers Mutual Accident Assn., Utica, N. Y.

Apr. 20, 1917 Burhop, W. H., Member, Wisconsin Compensation Insurance Board, State Capitol, Madison, Wis.

Feb. 19, 1915 Burns, F. Highlands, First Vice-President, Maryland Casualty Co., Baltimore, Md.

† Cammack, Edmund E., Associate Actuary, Aetna Life Ins. Co., Hartford, Conn.

† Carpenter, Raymond V., Assistant Actuary, Metropolitan Life Ins. Co., 1 Madison Ave., New York.

Feb. 19, 1915 §Case, Gordon, Assistant Examiner, New York Ins. Dept., 165 Broadway, New York.

Feb. 25, 1916 Close, Charles L., Manager, Bureau of Safety, U. S. Steel Corporation, 71 Broadway, New York.

Oct. 27, 1916 Cogswell, Edmund S., Third Deputy Insurance Commissioner, State House, Boston, Mass.

† Cole, Richard H., Secretary, Connecticut General Life Ins. Co., Hartford, Conn.

Feb. 19, 1915 Collins, Henry, Assistant Manager, Ocean Accident & Guarantee Corporation, 59 John St., New York.

† Conway, Charles T., Vice-President, Liberty Mutual Ins. Co., 30 E. 42d St., New York.

† Copeland, John A., Consulting Actuary, 1709 Third National Bank Building, Atlanta, Ga.

† Cowles, W. G., Vice-President, Travelers Ins. Co., Hartford, Conn.

† §Craig, Arthur H., Lieutenant, Machine Gun Training Center, Camp Hancock, Ga.

† Craig, James D., Assistant Actuary, Metropolitan Life Ins. Co., 1 Madison Ave., New York.

† Craig, James M., Actuary, Metropolitan Life Ins. Co., 1 Madison Ave., New York.

May 26, 1916 Crum, Frederick S., Assistant Statistician, Prudential Ins. Co., Newark, N. J.

† Daly, Thomas F., President, Capitol Life Ins. Co., Denver, Col.

† Dawson, Alfred B., Miles M. Dawson & Son, 141 Broadway, New York.

† Dawson, Miles M., Counsellor at Law and Consulting Actuary, 141 Broadway, New York.

† §De Kay, Eckford C., Recorder, New York Ins. Dept., 165 Broadway, New York. (Lieutenant-Commander.)

† Dearth, Elmer H., President, General Casualty & Surety Co., 114 Woodward Ave., Detroit, Mich.

May 19, 1915 Deutschberger, Samuel, Chief Examiner, Underwriters' Association Bureau, New York Ins. Dept., 165 Broadway, New York.

† Downey, E. H., Special Deputy, Insurance Department, Harrisburg, Pa.

†	Dublin, Louis I., Statistician, Metropolitan Life Ins. Co., 1 Madison Ave., New York.
May 19, 1915	Dunlap, Earl O., Metropolitan Life Ins. Co., 1 Madison Ave., New York.
†	§Egbert, Lester D., Office of Willcox, Peck, Brown & Crosby, Insurance Brokers, 3 S. William St., New York.
†	Epsteen, Saul, Wiggins, Col.
†	Fackler, David Parks, Consulting Actuary, 35 Nassau St., New York.
†	Fackler, Edward B., Consulting Actuary, 35 Nassau St., New York.
†	Fallow, Everett S., Assistant Actuary, Casualty Dept., Travelers Ins. Co., Hartford, Conn.
†	Farrer, Henry, Actuary, Hartford Accident & Indemnity Co., Hartford, Conn.
Feb. 25, 1916	Fay, Albert H., Statistician, U. S. Bureau of Mines, Washington, D. C.
Feb. 19, 1915	Fellows, C. W., Manager, State Compensation Ins. Fund, 525 Market St., San Francisco, Cal.
May 19, 1915	Fisher, Arne, Prudential Ins. Co. Newark, N. J.
†	Fitch, Frank M., Auditor, Hartford Steam Boiler Inspection & Ins. Co., Hartford, Conn.
Feb. 19, 1915	Flanigan, James E., Actuary, Bankers Life Co., Des Moines, Iowa.
†	Flynn, Benedict D., Assistant Secretary, Travelers Ins. Co., Hartford, Conn.
Feb. 15, 1915	Fondiller, Richard, Assistant Actuary, State Industrial Commission, 230 Fifth Ave., New York.
†	Forbes, Charles S., Forbes & Co. Inc., 66 Broadway, New York.
May 26, 1916	Frankel, Lee K., Third Vice-President, Metropolitan Life Ins. Co. 1 Madison Ave., New York.
†	Franklin, C. H., U. S. Manager, Frankfort General Ins. Co., 123 William St., New York.
Feb. 25, 1916	Froggatt, Joseph, President, Joseph Froggatt & Co., Insurance Accountants, 25 Church St., New York.
†	Furze, Harry, Comptroller, Globe Indemnity Co., 45 William St., New York.
Feb. 19, 1915	Garrison, Fred S., Assistant Secretary, Travelers Indemnity Co., Hartford, Conn.
†	Gaty, Theodore E., Vice-President and Secretary, Fidelity & Casualty Co., 92 Liberty St., New York.
May 19, 1915	Glover, James W., Consulting Actuary, University of Michigan, Ann Arbor, Mich.
†	Goodwin, Edward S., Care of F. R. Cooley and Co., Bankers, 49 Pearl St., Hartford, Conn.

† Gould, William H., Consulting Actuary, 256 Broadway, New York.

Oct. 22, 1915 Graham, George, Vice-President and Actuary, Missouri State Life Ins. Co., St. Louis, Mo.

Oct. 22, 1915 §Graham, T. Bertrand, Metropolitan Life Ins. Co., 1 Madison Ave., New York. (Captain.)

† Graham, William J., Third Vice-President, Equitable Life Assurance Society, 120 Broadway, New York.

† Grandfield, Robert E., Secretary, Industrial Accident Board, State House, Boston, Mass.

† Greene, Winfield W., Special Deputy Commissioner of Banking and Insurance, 20 Clinton St., Newark, N. J.

† Hamilton, R. C. L., Comptroller, Hartford Accident & Indemnity Co., Hartford, Conn.

† Hammond, H. Pierson, Actuary, Connecticut Ins. Dept., Hartford, Conn.

† Hansen, Carl M., Secretary, American Re-Insurance Co., Huntingdon, Pa.

Oct. 27, 1916 Hardy, Edward R., Assistant Manager, New York Fire Ins. Exchange, 123 William St., New York.

Oct. 22, 1915 Hatch, Leonard W., Chief Statistician, State Industrial Commission, Albany, N. Y.

Oct. 22, 1915 §Hess, Herbert, Sergeant, Base Hospital No. 15, American Expeditionary Force.

† Hillas, Robert J., President, Fidelity & Casualty Co., 92 Liberty St., New York.

Oct. 22, 1915 Hodgkins, L. G., Secretary, Masonic Protective Assn., Worcester, Mass.

† Hoffman, Frederick L., Third Vice-President and Statistician, Prudential Ins. Co., Newark, N. J.

Oct. 22, 1915 Holland, Charles H., Vice-President and General Manager, Royal Indemnity Co., 84 William St., New York.

† Hughes, Charles, Auditor and Assistant Actuary, New York Ins. Dept., 165 Broadway, New York.

† Hunt, Burritt A., Actuary, Liability Dept. Aetna Life Ins. Co., Hartford, Conn.

† Hunter, Arthur, Chief Actuary, New York Life Ins. Co., 346 Broadway, New York.

Feb. 25, 1916 Jackson, Charles W., Actuary, Postal Life Ins. Co., 511 Fifth Ave., New York.

May 19, 1915 Johnson, William C., Vice-President, Masonic Protective Assn., Worcester, Mass.

Oct. 22, 1915 Kime, Virgil M., Actuary, Casualty Dept. Travelers Ins. Co., Hartford, Conn.

†	King, Walter I., Superintendent, Group Insurance Dept., Connecticut General Life Ins. Co., Hartfort, Conn.
†	Kopf, Edwin W., Assistant Statistician, Metropolitan Life Ins. Co., 1 Madison Ave., New York.
Feb. 19, 1915	Laird, John M., Actuary, Connecticut General Life Ins. Co., Hartford, Conn.
Feb. 19, 1915	Landis, Abb, Consulting Actuary, 1107 Independent Life Building, Nashville, Tenn.
†	Law, Frank E., Vice-President, Fidelity & Casualty Co., 92 Liberty St., New York.
May 19, 1915	Lawson, F. W., U. S. Manager, London Guarantee & Accident Co., Ltd., 134 So. La Salle St., Chicago, Ill.
†	Leal, J. R., Actuary, Florida Ins. Dept., State Capitol, Tallahassee, Fla.
†	Leslie, William, Secretary-Actuary, State Compensation Ins. Fund, 525 Market St., San Francisco, Cal.
Feb. 19, 1915	Lubin, Harry, Public Service Commission, 49 Lafayette St., New York.
†	Luckett, D. G., Secretary, United States Casualty Co., 80 Maiden Lane, New York.
*Oct. 31, 1917	McManus, Robert J., Travelers Ins. Co., Hartford, Conn.
Feb. 19, 1915	Maddrill, James D., Actuary, U. S. Bureau of Efficiency, Washington, D. C.
†	Magoun, William N., General Manager, Massachusetts Rating & Inspection Bureau, 88 Broad St., Boston, Mass.
†	Marsh, W. B., Business Manager, The Economic World, 128 Water St., New York.
May 19, 1915	Maycrink, Emma C., New York Ins. Dept., 165 Broadway, New York.
Feb. 19, 1915	Mead, Franklin B., Secretary and Actuary, Lincoln National Life Ins. Co., Fort Wayne, Ind.
Apr. 20, 1917	Meltzer, Marcus, Statistician, National Workmen's Compensation Service Bureau, 13 Park Row, New York.
†	Michelbacher, G. F., Actuary, National Workmen's Compensation Service Bureau, 13 Park Row, New York.
†	Miller, David W., 354 New York Ave., Brooklyn, N. Y.
†	§Milligan, Samuel, Metropolitan Life Ins. Co., 1 Madison Ave., New York.
†	Mitchell, James F., First Asst. U. S. Manager, General Accident Fire and Life Assur. Corp., Fourth and Walnut Sts., Phila., Pa.

†	Moir, Henry, Actuary, Home Life Ins. Co., 256 Broadway, New York.
†	Moore, George D., Statistician, Royal Indemnity Co., 84 William St., New York.
†	Moore, W. S., Secretary-Treasurer, Guarantee Bonding & Ins. Co., Wichita, Kan.
May 19, 1915	Morris, Edward B., Actuary, Life Dept., Travelers Ins. Co., Hartford, Conn.
†	Morrison, James, Accountant, Royal Indemnity Co., 84 William St., New York.
†	Mowbray, Albert H., Vice-President and Actuary, Liberty Mutual Ins. Co., 185 Devonshire St., Boston, Mass.
May 20, 1918	Mudgett, Bruce D., Assistant Professor of Insurance, University of Washington, Seattle, Wash.
†	Mullaney, Frank R., Actuary, American Mutual Liability Ins. Co., 245 State St., Boston, Mass.
†	Nicholas, Lewis A., Statistician, Fidelity & Casualty Co., 92 Liberty St., New York.
†	Olifiers, Edward, Actuary, A Sul America, Rio-de-Janeiro, Brazil.
†	Orr, Robert K., President, Michigan Employers Casualty Co., Lansing, Mich.
†	Otis, Stanley L., Secretary, Insurance Federation of New York State, 80 Maiden Lane, New York.
†	Pallay, Julius J., Statistician, London Guarantee & Accident Co., Ltd., 134 So. La Salle St., Chicago, Ill.
May 26, 1916	Parker, Jr., John M., Secretary, Accident and Liability Department, Aetna Life Ins. Co., Hartford, Conn.
†	Reiter, Charles G., Assistant Actuary, Metropolitan Life Ins. Co., 1 Madison Ave., New York.
†	Remington, Charles H., Assistant Treasurer, Aetna Life Ins. Co., Hartford, Conn.
Feb. 19, 1915	Rolph, Mrs. Dorothy M., Director, Compensation Division, War Risk Bureau, Washington, D. C.
Oct. 22, 1915	Rowe, J. Scofield, Vice-President, Aetna Life Ins. Co., Hartford, Conn.
†	Rubinow, I. M., Federal Trade Commission, Washington, D. C.
†	Ryan, Harwood E., Actuary, New York Ins. Dept., 165 Broadway, New York.
†	Saxton, Arthur F., Chief Examiner of Casualty Companies, New York Ins. Dept., 165 Broadway, New York.
†	Scattergood, Claude E., Actuary, Morris Plan Insurance Society, 52 William St., New York.

†	Scheitlin, E., Statistician, Globe Indemnity Co., 45 William St., New York.
†	Senior, Leon S., Manager and Secretary, Compensation Inspection Rating Board, 135 William St., New York.
†	Smiley, J. W., Actuary and Chief Accountant to the West Virginia State Compensation Commissioner, Charleston, W. Va.
Apr. 20, 1917	Smith, Charles G., Actuary, New York Ins. Dept., Albany, New York.
Feb. 19, 1915	Smith, George Lambert, Consulting Actuary, 55 John St., New York.
Feb. 19, 1915	Stone, John T., President, Maryland Casualty Co., Baltimore, Md.
Feb. 25, 1916	Strong, Wendell M., Associate Actuary, Mutual Life Ins. Co., 32 Nassau St., New York.
Oct. 22, 1915	Strong, William Richard, 39 Streatham High Road, S. W. 16, London, England.
†	Sullivan, Robert J., Secretary, Liability Department, Travelers Ins. Co., Hartford, Conn.
May 19, 1915	Thiselton, Herbert C., General Manager, London Guarantee and Accident Co., Ltd., 20, 21 and 22 Lincoln's Inn Fields, London, W. C. 2, England.
†	Thompson, John S., Assistant Actuary, Mutual Life Ins. Co., 32 Nassau St., New York.
†	Train, John L., Secretary and General Manager, Utica Mutual Compensation Ins. Corp., 239 Genesee St., Utica, New York.
†	Whitney, Albert W., General Manager, National Workmen's Compensation Service Bureau, 13 Park Row, New York.
†	Wolfe, Lee J., Consulting Actuary, 165 Broadway, New York.
†	§Wolfe, S. Herbert, Lieutenant-Colonel, War Risk Bureau, Washington, D. C.
†	Woodward, Joseph H., Actuary, State Industrial Commission, 230 Fifth Ave., New York.
†	Young, William, Actuary, New York Life Ins. Co., 346 Broadway, New York.

ASSOCIATES.

The following have been enrolled as Associates upon examination by the Society.

Those marked (1) have passed Part I of the Fellowship Examination.

Those marked (§) are in the military or naval service of the United States.

Date Enrolled	
(1)Oct. 27, 1916	Baridon, Felix E., Travelers Ins. Co., Hartford, Conn.
Oct. 22, 1915	Baxter, Don A., Deputy Ins. Commissioner, Michigan Ins. Dept., Lansing, Mich.
Oct. 27, 1916	Bernstein, Abraham, Accountant, State Insurance Fund, 230 Fifth Ave., New York.
Oct. 31, 1917	Bessey, John M., Actuary, Millers Mutual Casualty Co., Chicago, Ill.
Oct. 22, 1915	Brann, Ralph M., Manager, Colorado Branch, National Workmen's Compensation Service Bureau, Denver, Col.
Oct. 22, 1915	Buffler, Louis, Jr., State Ins. Fund, 230 Fifth Ave., New York.
Oct. 31, 1917	Coates, Barrett N., The Fraternal Brotherhood, Los Angeles, Cal.
Oct. 22, 1915	§Feder, Marcy, Assistant Examiner, New York Ins. Dept., 165 Broadway, New York.
Oct. 31, 1917	Jackson, Edward T., Statistician, Maryland Casualty Co., Baltimore, Md.
Oct. 31, 1917	Kearney, T. P., Hartford Accident & Indemnity Co., Denver, Col.
Oct. 22, 1915	Levy, S. Leon, War Trade Board, Washington, D. C.
(1)Oct. 27, 1916	McClure, Laurence H., Aetna Life Ins. Co., Hartford, Conn.
Oct. 22, 1915	McGuire, Vincent G., 3056 Decatur Ave., New York.
(1)Oct. 27, 1916	§Miller, Tilford W., Travelers Ins. Co., Hartford, Conn.
Oct. 31, 1917	Montgomery, Victor, California Ins. Dept., San Francisco, Cal.
Oct. 31, 1917	§Mueller, Louis H., 11th Company, 166th Depot Brigade, American Expeditionary Force.
Oct. 22, 1915	Müller, Fritz, New York Life Ins. Co., 346 Broadway, New York.

(1) Oct. 27, 1916 Newell, William, Chief Safety Engineer, State Insurance Fund, 230 Fifth Ave., New York.
Oct. 22, 1915 Tilson, Howard, London Guarantee and Accident Co., 1423 Insurance Exchange, Chicago, Ill.
(1) Oct. 22, 1915 Van Tuyl, Hiram O., Assistant Examiner, New York Ins. Dept., 165 Broadway, New York.
(1) Oct. 27, 1916 Waite, A. W., Aetna Life Ins. Co., Hartford, Conn.
(1) Oct. 27, 1916 Waite, Harry V., Travelers Ins. Co., Hartford, Conn.
Oct. 22, 1915 Williamson, W. R., Assistant Actuary, Life Dept., Travelers Ins. Co., Hartford, Conn.
Oct. 22, 1915 Wood, Donald M., of Childs, Young & Wood, Insurance Exchange, Chicago, Ill.
Oct. 22, 1915 Woodman, Charles E., Examiner, New York Ins. Dept., 165 Broadway, New York.

SCHEDULE OF MEMBERSHIP, MAY 20, 1918.

	Fellows.	Associates.	Total.
Membership, October 31, 1917	144	25	169
By Withdrawal	1	—	1
	143	25	168
Addition:			
By Election, May 20, 1918	1	—	1
Membership, May 20, 1918	144	25	169

ABSTRACT FROM THE MINUTES OF THE MEETING, MAY 20 AND 21, 1918.

The tenth regular meeting of the Casualty Actuarial and Statistical Society of America was held at the Yale Club, New York City, on May 20 and 21, 1918.

President Craig called the meeting to order on the first day at 10:50 A.M. The roll was called, showing the following thirty-two Fellows and five Associates present:

FELLOWS.

BREIBY	FISHER	MILLIGAN
BRODIN	FLYNN	MOORE, G. D.
BUCK	FONDILLER	MOWBRAY
CAMMACK	HATCH	ORR
CRAIG, J. D.	HOFFMAN	RYAN
DEARTH	HUNT	SCATTERGOOD
DOWNEY	JACKSON, C. W.	SENIOR
DUNLAP	LUBIN	SMITH, C. G.
FACKLER, E. B.	MEAD	WHITNEY
FALLOW	MELTZER	WOODWARD
FARRER	MICHELBACHER	

ASSOCIATES.

BESSEY	MCCLURE	WILLIAMSON
JACKSON, E. T.	NEWELL	

The President's address was presented.

The minutes of the meeting held October 31 and November 1, 1917, were approved as printed in the *Proceedings*.

The report of the Council was read and, upon motion, adopted by the Society.

The Council recommended that the dues for the year ending November 7, 1918, and for subsequent fiscal years of the Society within the war period, be remitted to members of the Society who are in the military or naval service of the United States; and that arrears of dues for fiscal years of the Society prior to the one ending November 7, 1918, be collected. Upon motion duly seconded, the Society affirmed this recommendation.

The Council recommended Dr. Bruce D. Mudgett, Assistant Professor of Insurance at the University of Washington, Seattle, Washington, for election to Fellowship in the Society without examination, under the terms of Article III of the Constitution. After ballot, he was declared elected.

The Secretary-Treasurer's report was read and accepted.

The following amendments to the Constitution, concerning which proper notification had been given, were, on motion, adopted.

The third paragraph of Article III was amended to read as follows:

> "Any person may, upon nomination to the Council by two Fellows of the Society and approval by the Council of such nomination, with not more than one negative vote, become enrolled as an Associate of the Society, provided that he shall pass such examination as the Council may prescribe. Such examination may be waived in the case of a candidate who for a period of not less than two years has been in responsible charge of the statistical or actuarial department of a casualty insurance organization, or has had such other practical experience in casualty or social insurance as in the opinion of the Council renders him qualified for Associateship."

Article VII was amended to read as follows:

> "There shall be an annual meeting of the Society on such date in the month of November as may be fixed by the Council in each year, but other meetings may be called by the Council from time to time and shall be called by the President at any time upon the written request of ten Fellows. At least two weeks' notice of all meetings shall be given by the Secretary."

Recess was taken at 1:00 P.M. and at 2:30 P.M. the Society reconvened.

The papers printed in this number were read or presented and discussion was begun of the papers read at the last meeting of the Society.

A communication from Mr. Ralph H. Blanchard, concerning the educational program of the Society, was read and appears below.

The Society at 5:05 P.M. adjourned for dinner at 7:00 P.M. at the Yale Club. Hon. Job E. Hedges, General Counsel of the Association of Life Insurance Presidents, was the after-dinner speaker.

The Society's guests were:

Hon. Jesse S. Phillips, Superintendent of Insurance, State of New York.
Hon. James R. Young, Insurance Commissioner of North Carolina.
Hon. James V. Barry, Assistant Secretary, Metropolitan Life Insurance Company.
Mr. Luther B. Little, Metropolitan Life Insurance Company.

The Society reconvened on May 21 at 10:35 A.M., with President Craig in the chair.

The discussion of the papers read at the last meeting of the Society was resumed.

Written questions submitted by members of the Society to a "Question Box" were answered, upon the understanding that neither questions nor answers would be published.

Upon motion, the meeting adjourned at 1:15 P.M.

May 20, 1918.

TO THE EDITOR OF THE *Proceedings:*

Dear Sir:

Subject: Suggestion for an Educational Program.

The Casualty Actuarial and Statistical Society is fundamentally an educational institution. But it is not of elementary grade. The discussions at its meetings and the papers published in its *Proceedings* presuppose knowledge and appreciation of the fundamentals of actuarial and statistical science and of insurance. Its rules prescribe a certain measure of attainment as a prerequisite for membership and it is to be hoped that membership will become recognized as evidence of ability in the subjects to which it is devoted.

At present, those who attempt to prepare themselves for the examinations of the Society find it difficult to procure adequate printed material or personal assistance. On the availability of both of these depends the standard of preparation which may properly be set and the number of competitors from whom members may be selected. Until these sources of information are made available standards will be lower than they should be, applicants for examinations will be few and the development of the organization correspondingly delayed.

It is suggested, therefore, that the Society should adopt an educational program designed specifically to meet the needs of those who desire to take its examinations and that this program should be planned and carried out slowly and thoughtfully so that it may be of permanent value. With the purpose of promoting discussion and of focusing attention on the educational problem, the following program has been outlined. It is presented as a first attempt to develop a systematic scheme and in the hope that it may provoke constructive criticism and suggestions.

The first essential of an educational program is a syllabus indicating the subjects to be covered, arranging them in logical order, and giving references for reading. Such a syllabus should define the limits of each subject and state briefly its bearing on the problems with which the Society is concerned, the subjects being divided to correspond with the various sections of the examinations. References for reading should be specific, arranged in proper sequence and some valuation of each presented. As a basis for a syllabus, the Educational Committee has prepared a tentative draft of subjects as given below:

Suggested Outline of Subjects of Study for the Examinations of the Casualty Actuarial and Statistical Society of America.

I. Economics.
  A. General economics.
  B. Economic theory of insurance.
    1. Private insurance.
    2. Governmental insurance.
  C. Accounting (General).
  D. Stocks and bonds.

II. Practice of insurance.
  A. Organization.
    1. Stock companies.
    2. Mutual associations.
    3. State insurance.
    4. Self-insurance.
  B. Kinds of insurance (leading lines under each heading).
    1. Life insurance.
    2. Fire insurance.
    3. Marine insurance.
    4. Casualty insurance.
  C. Forms of coverage.
    1. Contracts.
  D. Underwriting practice.
  E. Investigation and adjustment of claims.
  F. Prevention and conservation.
  G. Insurance law (restricted to especially important subjects, such as compensation laws, standard provisions, etc.).
  H. Insurance accounting.
    1. Annual statements.
    2. Tax statements.
    3. Special statements.
  I. Investments.

III. Statistics.
  A. Statistical method and practice.
    1. Collection of material.
    2. Tabulation.
    3. Graphic presentation.

IV. Mathematics.
  A. Pure mathematics.
    1. Algebra.
    2. Trigonometry.
    3. Geometry.
    4. Calculus.
  B. Applied mathematics.
    1. Mathematical theory of statistics.
      a. Theory of probability.
      b. Least squares.
    2. Mathematical theory of investment.

C. Insurance mathematics.
1. Life contingencies.
2. Calculation of premiums for casualty insurance.
   a. Manual premiums.
   b. Merit rating.
      (1) Schedule rating.
      (2) Experience rating.
3. Calculation of reserves.
   a. Unearned premium reserves.
   b. Loss reserves.
4. Pension funds.
   a. Premiums.
   b. Valuation.

The greatest difficulty in preparing lists of references for reading under these various heads is encountered in the casualty field. The student needs clear, elementary, up-to-date statements of principles and practices as a basis for the study of the more technical phases of insurance. With very few exceptions, no such statements are available.

To supply this want it is suggested that the Society should issue a series of pamphlets, each dealing with a recognized unit of insurance practice or theory and written by a specialist in the particular branch covered.* Each pamphlet should fit into a logical arrangement planned in advance so that the series of pamphlets might be combined to form a complete elementary text. Accuracy of statement and clearness of exposition would be especially important in order to minimize the necessity of collateral explanation. It would be well to have all technical terms listed and defined as an aid to comprehension and as a contribution to standardization of use in insurance circles. The extent of treatment of such subject would depend on its importance in insurance.

Responsibility for the preparation and for the content and form of these pamphlets should be centered in an editor-in-chief, who should have considerable latitude in revising original manuscript; always, of course, in consultation with the author. Each should be issued with the approval of the Educational Committee and, through them, of the Society.

Such a text would furnish students with a basis for study for examinations and would be particularly useful to those situated in the more remote localities. It would contribute to the standardization of insurance terms. An authoritative, well-balanced and well-written text would add to the prestige of the Society, both among those specifically interested in its progress, and among students of insurance who might have occasion to use portions of the text. Valuable space in the *Proceedings* would be released for the discussion of problems.

* The writer originally made this suggestion to the Educational Committee of this Society at a meeting held December 15, 1917.

Issuance in pamphlet form has many advantages. It is inexpensive and permits a trial of the scheme without undue financial risk. If the pamphlets prove popular, they should pay for themselves or even result in a profit. The first numbers could be published with a minimum of delay. Revisions of a text in book form are difficult and expensive, but, under this plan, an obsolete treatment of a subject could easily be replaced, an important consideration in casualty insurance. Further, it enables those who are interested only in particular branches of insurance to select the individual papers with which they are concerned.

But no text or combination of readings is sufficient to secure the best results in the preparation of candidates for examination. Courses of instruction in charge of competent men should be established by independent groups or in connection with universities or insurance institutes. Formal approval of such courses by the Society might be unwise, but it could assist materially with suggestions and encouragement and particularly by securing the cooperation of members. These courses, combined with adequate printed material, ought to contribute a great deal to the development of a promising field of candidates and eventually to increased usefulness of the organization. Where regular courses cannot be organized it might be possible to arrange for series of conferences where students could secure assistance.

This suggested program has been made purposely general. Before the Society can proceed to develop a detailed educational plan it is necessary to consider along what lines it will be most profitable to work. That some sort of program is necessary for adequate development will probably be agreed. If this paper results in the discussion and formulation of such a program, it will have accomplished its purpose.

Yours very truly,

RALPH H. BLANCHARD.

CONSTITUTION.

(As Amended May 20, 1918.)

Article I.—*Name.* This organization shall be called The Casualty Actuarial and Statistical Society of America.

Article II.—*Object.* The object of the Society shall be the promotion of actuarial and statistical science as applied to the problems of casualty and social insurance by means of personal intercourse, the presentation and discussion of appropriate papers, the collection of a library and such other means as may be found desirable.

The Society shall take no partisan attitude, by resolution or otherwise, upon any question relating to casualty or social insurance.

Article III.—*Membership.* The membership of the Society shall be composed of two classes, Fellows and Associates. Fellows only shall be eligible to office or have the right to vote.

The Fellows of the Society shall be the present members and those who may be duly admitted to Fellowship as hereinafter provided. Any Associate of the Society may apply to the Council for admission to Fellowship. If his or her application shall be approved by the Council with not more than one negative vote he or she shall become a Fellow on passing such final examination as the Council may prescribe. Otherwise no one shall be admitted as a Fellow unless recommended by a duly called meeting of the Council with not more than one negative vote followed by a ballot of the Society with not more than four negative votes and not less than twenty affirmative votes.

Any person may, upon nomination to the Council by two Fellows of the Society and approval by the Council of such nomination with not more than one negative vote, become enrolled as an Associate of the Society provided that he shall pass such examination as the Council may prescribe. Such examination may be waived in the case of a candidate who for a period of not less than two years has been in responsible charge of the statistical or actuarial department of a casualty insurance organization or has had such other practical experience in casualty or social insurance as in the opinion of the Council renders him qualified for Associateship.

Article IV.—*Officers and Council.* The officers of the Society shall be a President, two Vice-Presidents, a Secretary-Treasurer, an Editor, and a Librarian. The officers with ex-Presidents, ex-Vice-Presidents and four other Fellows shall constitute the Council.

Article V.—*Election of Officers and Council.* The officers shall be elected by a majority ballot at the annual meeting for the term of one year and two members of the Council shall, in a similar manner, be annually elected to serve for two years. The President and Vice-Presidents shall not be eligible for the same office for

more than two consecutive years nor shall any retiring member of the Council be eligible for re-election at the same meeting.

ARTICLE VI.—*Duties of Officers and Council.* The duties of the officers shall be such as usually appertain to their respective offices or may be specified in the by-laws. The duties of the Council shall be to pass upon candidates for membership, to decide upon papers offered for reading at the meetings, to supervise the examination of candidates and prescribe fees therefor, to call meetings, and, in general, through the appointment of committees and otherwise, to manage the affairs of the Society.

ARTICLE VII.—*Meetings.* There shall be an annual meeting of the Society on such date in the month of November as may be fixed by the Council in each year, but other meetings may be called by the Council from time to time and shall be called by the President at any time upon the written request of ten Fellows. At least two weeks notice of all meetings shall be given by the Secretary.

ARTICLE VIII.—*Quorum.* A majority, or seven members, of the Council shall constitute a quorum. Twenty Fellows of the Society shall constitute a quorum.

ARTICLE IX.—*Expulsion or Suspension of Members.* Except for non-payment of dues no member of the Society shall be expelled or suspended save upon action by the Council with not more than one negative vote followed by a two-thirds ballot of the Fellows present and voting at a meeting of the Society.

ARTICLE X.—*Amendments.* This constitution may be amended by an affirmative vote of two-thirds of the Fellows present at any meeting held at least one month after notice of such proposed amendment shall have been sent to each Fellow by the Secretary.

BY-LAWS.

(AS AMENDED OCTOBER 27, 1916.)

ARTICLE I.—*Order of Business.* At a meeting of the Society the following order of business shall be observed unless the Society votes otherwise for the time being:

1. Calling of the roll.
2. Address or remarks by the President.
3. Minutes of the last meeting.
4. Report by the Council on business transacted by it since the last meeting of the Society.
5. New membership.
6. Reports of officers and committees.
7. Election of officers and Council (at annual meetings only).
8. Unfinished business.
9. New business.
10. Reading of papers.
11. Discussion of papers.

ARTICLE II.—*Council Meetings.* Meetings of the Council shall be called whenever the President or three members of the Council

so request, but not without sending notice to each member of the Council seven or more days before the time appointed. Such notice shall state the objects intended to be brought before the meeting, and should other matter be passed upon, any member of the Council shall have the right to re-open the question at the next meeting.

ARTICLE III.—*Duties of Officers.* The President, or, in his absence, one of the Vice-Presidents, shall preside at meetings of the Society and of the Council. At the Society meetings the presiding officer shall vote only in case of a tie, but at the Council meetings he may vote in all cases.

The Secretary-Treasurer shall keep a full and accurate record of the proceedings at the meetings of the Society and of the Council, send out calls for the said meetings, and, with the approval of the President and Council, carry on the correspondence of the Society. Subject to the direction of the Council, he shall have immediate charge of the office and archives of the Society.

The Secretary-Treasurer shall also send out calls for annual dues and acknowledge receipt of same; pay all bills approved by the President for expenditures authorized by the Council of the Society; keep a detailed account of all receipts and expenditures, and present an abstract of the same at the annual meetings, after it has been audited by a committee of the Council.

The Editor shall, under the general supervision of the Council, have charge of all matters connected with editing and printing the Society's publications. The *Proceedings* shall contain only the proceedings of the meetings, original papers or reviews written by members, discussions on said papers and other matter expressly authorized by the Council.

The Librarian shall, under the general supervision of the Council, have charge of the books, pamphlets, manuscripts and other literary or scientific material collected by the Society.

ARTICLE IV.—*Dues.* The dues shall be ten dollars for Fellows and five dollars for Associates payable upon entrance and at each annual meeting thereafter, except in the case of Fellows not residing in the United States, Canada, or Mexico, who shall pay five dollars at the times stated.

It shall be the duty of the Secretary-Treasurer to notify by mail any Fellow or Associate whose dues may be six months in arrears, and to accompany such notice by a copy of this article. If such Fellow or Associate shall fail to pay his dues within three months from the date of mailing such notice, his name shall be stricken from the rolls, and he shall thereupon cease to be a Fellow or Associate of the Society. He may, however, be reinstated by vote of the Council, and upon payment of arrears of dues.

ARTICLE V.—*Amendments.* These by-laws may be amended by an affirmative vote of two-thirds of the Fellows present at any meeting held at least one month after notice of the proposed amendment shall have been sent to each Fellow by the Secretary.

RULES REGARDING EXAMINATIONS FOR ADMISSION TO THE SOCIETY.

(AS AMENDED MAY 20, 1918.)

The Council adopted the following rules providing for the examination system of the Society:

1. Examinations will be held on the first Wednesday and Thursday during the month of May in each year in such cities as will be convenient for three or more candidates.

2. Application for admission to examination should be made on the Society's blank form, which may be obtained from the Secretary-Treasurer. No applications will be considered unless received before the fifteenth day of March preceding the dates of examination.

3. A fee of $5.00 will be charged for admission to examination. This fee is the same whether the candidate sits for one or two parts and is payable for each year in which the candidate presents himself. Examination fees are payable to the Secretary-Treasurer and must be in his hands before the fifteenth day of March preceding the dates of examination.

4. The examination for Associateship consists of four parts. Not more than two parts can be taken in the same year and no credit will be given for the passing of any part unless all previous parts have been passed during the same or previous years. If a candidate takes two parts in the same year and passes in one and fails in the other, he will be given credit for the part passed.

5. In the case of applicants not less than thirty years of age, who have had not less than five years' experience in actuarial or statistical work in insurance offices, the Council may, upon receipt of satisfactory evidence of general education, waive the passing of Parts I, II and III of the Associateship examination. Such applicants may thereupon become Associates by passing Part IV of the Associateship examination.

6. Admission to Fellowship examinations is granted only to those who are Associates of the Society. The examination for Fellowship is divided into two parts. No candidate will be permitted to present himself for Part II unless he has previously passed in Part I or takes Parts I and II in the same year. If a candidate takes both parts in the same year and passes in one and fails in the other, he will be given credit for the part passed.

7. As an alternative to the passing of Part II of the Fellowship examination, a candidate may elect to present an original thesis on an approved subject relating to casualty or social insurance. Candidates electing this alternative should communicate with the

Secretary-Treasurer as to the approval of the subject chosen. All theses must be in the hands of the Secretary-Treasurer before the first Thursday in May of the year in which they are to be considered. Where Part I of the Fellowship examination is not taken during the same year, no examination fee will be required in connection with the presentation of a thesis. All theses submitted are, if accepted, to be the property of the Society and may, with the approval of the Council, be printed in the *Proceedings*.

8. In Part II of the Fellowship examination the papers will be so arranged that it will be necessary for the candidate to write on only three of the four prescribed topics in order to obtain full credit.

9. *Special attention is called to the following important exception to the above rules effective as respects the year 1918.* Examinations will be regularly held in May, 1918, but in the case of candidates for Associateship presenting themselves at that time the passing of Parts I and II will be waived and the candidates will be required to take Parts III and IV only. Commencing with 1919, candidates for Associateship will be expected to pass in all four Parts of the Syllabus.

Syllabus of Examinations.

For Enrollment as Associate.

Part I:

1. Elementary algebra up to and including the binomial theorem.
2. Elementary plane trigonometry including the use of logarithms.
3. Elementary plane analytical geometry.
4. Double entry bookkeeping.

Part II:

1. Advanced algebra.
2. Elementary differential and integral calculus.
3. Elementary calculus of finite differences.
4. Theory of probability and least squares.

Part III:

1. Compound interest and annuities-certain.
2. Theory of statistics.
3. Elements of the theory of life annuities and assurances, including the calculation of premiums and reserves for the simpler forms of policy.
4. Elements of economics.

Part IV:

1. Practical problems in statistics.
2. Policy forms and underwriting practice in casualty insurance, viz.: Personal accident, health, liability, workmen's compensation, fidelity, surety, plate glass, steam boiler, burglary, fly wheel, automobile, workmen's collective, credit.

3. Practical problems in insurance accounting and statistics, including the preparation of annual statements.
4. Insurance law, including the more important statutes of the United States and Canada relating to casualty insurance.

For Admission as Fellow.

Part I:

1. Calculation of premiums and reserves for accident, sickness, workmen's compensation and other branches of casualty insurance.
2. Inspection of risks; adjustment and settlement of claims.
3. Investments of insurance companies.
4. Current problems in workmen's compensation and other branches of casualty insurance.

Part II:

1. Principles and history of social insurance.
2. Compilation and use of census or other government statistics relating to population, mortality, invalidity, sickness, unemployment, old age and allied matters.
3. Systems of invalidity, old age and unemployment insurance.
4. Calculation of premiums for and valuation of pension funds.

A copy of a pamphlet entitled "Recommendations for Study in Connection with the Examinations of the Casualty Actuarial and Statistical Society of America" may be obtained upon application to the Secretary.

EXAMINATIONS OF THE SOCIETY.

EXAMINATION COMMITTEE.

G. F. MICHELBACHER (CHAIRMAN).

In Charge of Associateship Examinations.	*In Charge of Fellowship Examinations.*
EDWIN W. KOPF (CHAIRMAN)	CHARLES G. SMITH (CHAIRMAN)
JAMES D. MADDRILL	EDMUND S. COGSWELL
FRANK R. MULLANEY	CHARLES S. FORBES

EXAMINATION FOR ADMISSION AS ASSOCIATE.

MAY 1, 1918.

PART III. FIRST PAPER.

Time: 9.30 until 12.30 o'clock.

1. Name and define the three chief forms of assets recognized in general economics.

2. (*a*) Find the value of an annuity payable annually whose several payments are 1, 2, 3, 4, etc., when the annuity is to run (1) for n years; (2) forever.

(*b*) How many decimal places must a logarithm table have to be sufficient to determine to the cent the present value of 300 weekly payments of $10 at ordinary interest rates?

3. Deduce a formula for the net single premium for a life annuity with the provision that in case of the death of the annuitant before the total annuity payments equal the single premium paid to the company, the excess shall be returned. Ignore the question of loading.

4. Explain briefly the "impatience theory of interest."

5. (*a*) Distinguish between *median group* and *median item* of a frequency distribution.

(*b*) Given two frequency distributions each of cases of a particular injury or sickness, according to classified days of disability for work; how would you *compute* and *interpret* the "standard deviation" of each distribution?

6. How would you construct tables showing the prices of bonds bearing various rates of interest and redeemable at par in any number of years, such that they will yield various rates of interest per annum, from 2½ per cent. up to 6 per cent. increasing by $\frac{1}{20}$ of 1 per cent.?

7. Define m_x and q_x; prove that

$$m_x = q_x + \frac{(q_x)^2}{2} + \frac{(q_x)^2}{4} + \cdots$$

8. (*a*) What is meant by "weighted arithmetic mean?"

(*b*) Outline a "short-cut" method of computing the weighted arithmetic mean of a frequency distribution of wages in an industry.

PART III. SECOND PAPER.

Time: 1.30 until 4.30 o'clock.

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9. How would you calculate the present value of $1 a week, payments at the end of each week, for 500 weeks, at simple interest 5 per cent. per annum?

10. Point out the fallacy in the following statement: "Interest is low when money is plentiful."

11. Answer one of the following:

(*a*) Given P_x, l_x, l_{x+1} and a_{x+1}, find an expression for i.

(*b*) At 5 per cent. interest A is .90476 when $a=1$. What is the value of A when $a=3.1$; when $a=7.3$?

12. How would you proceed to test the following statement: "Immigration appears to be a business barometer when *correlated* with yearly wholesale prices." How do you establish that there is *correlation* between two variables, and by what means do you measure it? Give formulae.

13. What is meant by "inflation of currency?" What are its causes and consequences in respect to prices during wartime?

14. Define "equated time of payment" for a number of sums due at different times, and deduce the approximate value customarily used. Prove that this approximate value is greater than the true equated time.

15. Answer one of the following:

(*a*) Define "moving average." State how you would smooth a series by means of "moving averages."

(*b*) State the meaning of

Normal probability distribution.
Probable error.

16. Give a clear definition of what is meant by "reserve" in life insurance. Explain the prospective and retrospective methods of computing reserves. Show for an ordinary life policy that the one is algebraically the equivalent of the other.

MAY 2, 1918.

PART IV. FIRST PAPER.

Time: 9.30 until 12.30 o'clock.

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1. Discuss the propriety of (*a*) lump sum settlement of compensation claims; (*b*) instalment settlement of claims under personal accident policies.

2. A company issued a burglary policy on July 1, 1900, to run for six years upon payment of a single premium. What percentage of the original premium was unearned (*a*) on December 31, 1900; (*b*) on December 31, 1901?

3. Outline a practical statistical method for determining a measure of the relative severity of accidents in workmen's compensation experience.

4. Answer one of the following:

(*a*) Describe briefly the benefits payable under the War Risk Insurance Act to soldiers and sailors.

(*b*) Discuss the propriety of the option of soldiers and sailors to insure for amounts up to $10,000 under the Act.

5. Explain the two kinds of inspections made throughout the life of a boiler insurance policy.

6. Draft a table to show the number and relationship of dependents of persons insured under an Act providing benefits for permanent total disability, distinguishing sex and age of such dependents.

7. What are the so-called "standard limits" in liability policies with respect to (*a*) damages arising from injury to one person and (*b*) damages arising from injuries to several persons in any one accident?

8. In the annual statement blank would it be possible for an item to appear in your "receipts" and not affect the "income?" Give examples.

PART IV. SECOND PAPER.

Time: 1.30 until 4.30 o'clock.

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9. Sketch a sorting or punch experience card for liability and workmen's compensation and draft a table or tables, to show pure claim cost per $100 of payroll (*a*) by policy year (*b*) by form of contract and (*c*) by industry class.

10. What are the three fundamental underwriting principles of plate glass insurance?

11. Present the following table graphically:

NUMBER OF EMPLOYEES AND AMOUNT OF GROUP INSURANCE IN FORCE ON SPECIFIED DATE.

Date.	Number of Employees.	Amount of Insurance.
December 31, 1912	11,450	$13,083,000
December 31, 1913	30,125	$28,235,000
December 31, 1914	52,625	$50,605,000
December 31, 1915	105,000	$83,920,000
December 31, 1916	202,000	$155,300,000

12. How has workmen's compensation generally modified the rules of common law as to master and servant?

13. Enumerate and define the hazards covered in public liability insurance.

14. Answer one of the following:

(*a*) Outline the main classes or general characteristics of the classification of accidents and injuries, or of sicknesses and deaths, with which you are most familiar. State the circumstances under which the classification originated, the revisions it has undergone and the changes you recommend to increase its usefulness.

(*b*) Discuss the advantages and disadvantages of wage statistics shown as (*a*) average wages, (*b*) classified wages, (*c*) modal wages. Give practical applications.

15. Answer one of the following:

(*a*) Assuming that matters other than expense of workmen's compensation insurance are equal, discuss the advantage or disadvantage of a manufacturing plant employing 10,000 persons locating in Pennsylvania rather than in Massachusetts.

(*b*) Comment on the joint and several assumption of hazardous risks by an association of insurers.

16. Discuss a basis of pro-rates for expense allocation in a company transacting multiple casualty lines.

EXAMINATION FOR ADMISSION AS FELLOW.

MAY 1, 1918.

PART I. FIRST PAPER.

Time: 9.30 until 12.30 o'clock.

1. (*a*) Upon what reasoning is a "minimum premium" charge based?

(*b*) Outline some of the recent developments in connection with the calculation of minimum premiums for workmen's compensation insurance.

2. Company "A" reinsures company "B" as of May 1, 1917, receiving the pro rata unearned premiums on company "B's" unexpired policies computed on each individual policy. What method should be used in compiling the unearned premium reserve as of December 31, 1917, of the annual statement of company "A"?

3. (*a*) Name five (5) conditions you would be on the lookout for if you were inspecting a manufacturing plant in connection with workmen's compensation insurance.

(*b*) State your idea of a proper method for guarding each of the following:

1. Stairways
2. Floor openings
3. Elevated runways.

4. Discuss briefly the changes in the security market between the beginning and end of 1917. Show the effect on the financial condition of insurance companies. What measures were adopted by insurance officials to meet this conditoin? Give arguments for or against this expedient.

5. The statement is made that the frequency of compensable accidents is greater among men recently employed than among more experienced men, and the following data are advanced in support of this assertion:

Total number of accidents in a year in a large plant	310
Of which workmen employed under six months suffered	103
Workmen employed from six months to one year suffered	54
Workmen employed from one year to three years suffered	59
Workmen employed from three years to five years suffered ...	50
Workmen employed from five years to ten years suffered	30
Workmen employed from ten years to fifteen years suffered ..	8
And workmen employed over fifteen years suffered	6

Comment on the argument as outlined above. Would you draw the same conclusion from the facts given? Give reason for answer.

6. Discuss two different methods of providing an expense loading for workmen's compensation insurance rates.

7. The management of your company wishes a report on the desirability of continuing certain lines of casualty insurance in a given state. Outline the nature of the investigation you would make and the points you would present in your report. (Choose any state, and two lines of insurance other than workmen's compensation.)

8. What is the fundamental theory of anti-discrimination laws? Are they desirable or undesirable from a company standpoint? Give some arguments in support of your opinion.

PART I. SECOND PAPER.

Time: 1.30 until 4.30 o'clock.

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9. Describe the methods now used in obtaining classifications and rates for the different lines of automobile insurance.

10. Discuss the new methods of statistical investigation made possible by the introduction of sorting and tabulating machines.

11. A casualty company suffers the loss of all its records by fire with the exception of all the applications. The accountant is asked to compile the unearned premium reserve as of March 31. What method should he use in doing this?

12. (*a*) What is the purpose of "experience rating" in workmen's compensation insurance?

(*b*) What requirements must an experience rating plan satisfy before general adoption?

(*c*) What are the essential features of some experience rating plan in present use?

13. In an emergency, a young physician just graduated from a medical school is secured to make an examination in a public liability case. If you were the adjuster representing the company, what instructions would you give him?

14. (*a*) What sort of an argument would you, as the actuary of a stock casualty company, prepare for presentation to a large corporation manufacturing locomotives, who are insured in your company and who are considering the advisability of self-insurance? Would you vary the above if the corporation were making watches instead of locomotives, and if so, how?

(*b*) Discuss self-insurance from the standpoint of public policy.

15. The treasurer of a fire company is elected treasurer of a casualty company. All investments are handled by him. Should

he pursue the same methods in handling the investments which he used in the fire company? Is it necessary for him to keep relatively a larger or a smaller cash balance than he maintained in the fire company?

16. (*a*) Describe briefly four different methods of safeguarding an insurance carrier against sudden heavy losses.

(*b*) Mention four casualty lines which are subject to the possibility of such sudden shocks.

(*c*) Mention four casualty lines where the probability of such a shock is very remote.

MAY 2, 1918.

PART II. FIRST PAPER.

Time: 9.30 until 12.30 o'clock.

NOTE: In accordance with Rule 8 of the rules regarding examinations for admission to the Society candidates who are to be examined in Part II of the Fellowship examinations are required to write on only three of the four prescribed topics, in order to obtain full credit. For this reason, the examination questions are so arranged that it will be possible for the candidate to choose three of the four topics for his examination. A choice of topics is binding for both morning and afternoon papers; that is to say, if you choose as the subjects for your examination topics 1, 2 and 3, you must be careful to limit yourself to the questions on these topics both in the morning and afternoon examinations.

TOPIC 1.

PRINCIPLES AND HISTORY OF SOCIAL INSURANCE.

1. (*a*) What facts should be considered in determining the percentage of disability in a permanent partial case, in a state where the percentage method of compensation is in vogue?

(*b*) Upon what theory should compensation be allowed for disfigurement (in the absence of other disability)?

2. Give a general outline of the scope of the German social insurance system. What modifications, if any, would be required to adapt such a system to conditions in the United States? Give reasons for your answer.

TOPIC 2.

COMPILATION AND USE OF CENSUS OR OTHER GOVERNMENT STATISTICS RELATING TO POPULATION, MORTALITY, INVALIDITY, SICKNESS, UNEMPLOYMENT, OLD AGE AND ALLIED MATTERS.

3. (*a*) The crude death rate of Fall River, Mass., is given as 15.9 per thousand; that of Dayton, Ohio, is stated to be 13.6 per thousand. What conclusions, if any, would you draw from these figures as to (1) the comparative merits of the two cities from a sanitary standpoint; (2) characteristics of mortality tables necessary to determine the experience of the respective cities?

(*b*) Census returns show a high death rate from tuberculosis in Colorado as compared with New York; yet a physician advises a patient threatened with tuberculosis to live in Colorado. How can he reconcile this advice with the statistical returns?

4. (*a*) In investigating the death rates of particular limited areas, how would you treat

(*a*) Deaths in institutions?

(*b*) Deaths of non-residents?

(*b*) The census of 1910 showed that there were in the United States 3,176,228 widows and 1,471,390 widowers. It is argued, therefore, that women, on the average, live much longer than their husbands. Comment on the propriety of using these facts to support the argument. What conclusions would you draw from the figures quoted?

5. Mention a few subjects which are regularly investigated by the Census Bureau during the intercensal periods. Mention two new lines of investigation of service to casualty and social insurance which might appropriately be added to those already undertaken by the Bureau.

TOPIC 3.

SYSTEMS OF INVALIDITY, OLD AGE AND UNEMPLOYMENT INSURANCE.

6. A bill is pending, providing for compulsory health insurance, affecting all employees earning less than $100 per month, and providing for an equal division of cost between the employees and the employers. It is claimed that such a law would be unconstitutional in America, impracticable, and that the cost would be prohibitive. Comment on the above statements. How would you proceed to estimate the total annual cost of such a bill for a given

state? What special reasons, if any, are believed to exist at the present time for pressing such a measure?

7. Suppose you have been engaged by a state legislature to study the problem of old age pensions. How would you proceed in making your investigation and report?

TOPIC 4.

Calculation of Premiums for and Valuation of Pension Funds.

8. Name the principal features and benefits of the United States War Risk Insurance Act, so far as it applies to men in the army and navy. Will this act, in your opinion, obviate the necessity of granting a large number of pensions after the war? Give reasons.

9. Outline a general scheme for pensions to civil service employees in a given state, giving briefly

(1) Benefits { kind; age of retirement. / amount; length of service.
(2) Beneficiaries.
(3) Methods and extent of contributions { state. / employee.
(4) Administration.

10. What advantages can a state expect from the establishment of a retirement system for public school teachers? Describe some retirement system for teachers now in operation and point out its advantages and disadvantages.

Part II. Second Paper.

Time: 1.30 until 4.30 o'clock.

TOPIC 1.

Principles and History of Social Insurance.

11. What are some of the fundamental assumptions underlying social insurance plans?

12. In what state does the workmen's compensation law in your opinion most nearly approach an ideal law, from the public stand-

point? In what way could this particular law be improved?

13. Relate the circumstances leading to the adoption of old age pensions in England. Has the system realized the expectations of its advocates?

TOPIC 2.

Compilation and Use of Census or Other Government Statistics Relating to Population, Mortality, Invalidity, Sickness, Unemployment, Old Age and Allied Matters.

14. Outline a statistical inquiry regarding employment and unemployment. What material would you require? How and where would you get it? How would you analyze it and present the results?

15. (*a*) Explain what is meant by "center of population." How is its location determined, and what has been the general direction of its movement since 1790? In what respect does it differ from the "median point of population?" Which point is more sensitive to changes in population distribution and why?

(*b*) Does the census show an excess of females over males, or vice versa, in the general population? What variations of this ratio are found as between various sections of the country? How are such variations accounted for?

TOPIC 3.

Systems of Invalidity, Old Age and Unemployment Insurance.

16. Describe a system of unemployment insurance. In what countries has such a system been successfully operated?

17. Give the principal arguments for and against a system of old age pensions (*a*) with contributions, (*b*) supported entirely by the government.

18. What is the modern conception of the government's obligation to a crippled or disabled soldier, and what is being done to work it out in a practical way in some one of the belligerent countries?

TOPIC 4.

Calculation of Premiums for and Valuation of Pension Funds.

19. In drafting a plan for old age pensions in a given state, at what age would you have the pensions begin? Would you provide

any benefits payable prior to the attained age so adopted? If so, what? What qualifications, if any, besides proof of age, would you require before granting a pension to a given individual? How would you fix the amount of pension to be allowed under the system? Would you vary it in any way as between individual beneficiaries?

20. Give a brief account of a particular investigation into retirement systems, commenting on the conditions revealed, and the recommendations made by the investigator.

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