VOLUME III, PART I NUMBER 7

PROCEEDINGS

OF

The Casualty Actuarial and Statistical Society of America

OCTOBER 27 and 28, 1916

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PAPERS IN THE PROCEEDINGS

(*Continued on inside of back cover.*)

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NOTICE.

The Society is not responsible for statements made or opinions expressed in the articles, criticisms and discussions published in these *Proceedings*.

VOLUME III, PART I. NUMBER 7.

PROCEEDINGS

OCTOBER 27 AND 28, 1916.

ADDRESS OF THE PRESIDENT, I. M. RUBINOW.

It is a matter of very deep regret that I am unable to be present at this third annual meeting of the Society, and to express to every member my deep appreciation of cordial relations enjoyed during the two years of my incumbency in the valued office of President.

I hoped at least to be able to perform my last official duty and present a careful review of the achievements of our Society in furthering the insurance science in this country during our brief existence. Unfortunately, pressure of work here at the Pacific Coast is so tremendous, and the time at my disposal to complete it in, is so short, that even that privilege must be foregone. And yet, except for my personal disappointment, perhaps this is of lesser importance than it would have been but for the obvious success of the C.A.S.S.A.

There is perhaps a compensating advantage in being able to view our work from the distance of 3,000 miles, to be able to see clearly that our work has been and will be in an increasing degree of nation-wide significance, of almost epoch-making importance. It was but two or three years ago, when compensation insurance first assumed substantial dimensions in this country, that it still appeared like a speculative business with hardly any point of contact with mathematics, statistics or social and economic science. Within that short period casualty and social insurance has gained for itself a definite position, not only in the business world, not only in the scientific world, but as a weighty force in social progress, and no doubt we are all human enough, no doubt we are all citizens enough, to value this last achievement above all others.

It is no exaggeration to say that the measure of success which was meted out to us is perhaps without parallel in the history of

scientific organizations. Not only have we in these brief two years established a scientific publication, which is and will remain the standard in its own field, not only have we gained the recognition of new dignity in our profession, not only have we managed to command respectful attention and almost envy in several foreign countries of older culture and longer experience in our own line of endeavor, but more than that we are able to claim this valuable service to the American people—that in a true spirit of preparedness we have constructed the tools, through which the solution of the grave problems of poverty and destitution will be considerably simplified and made easier.

It would be a very vain man who would dare to claim all the credit for these achievements of two years, for the stimulus that was given by broad and complex social forces, for the splendid scientific efforts that were contributed perhaps by a larger percentage of membership than in the case of any other similar organization during a corresponding stage of its existence, and yet, I wonder if I make myself subject to a charge of excessive vanity if I say that among all the treasures of my memory the fact that I happened to be the one to suggest the organization of the C.A.S.S.A. and was willing to insist upon it even in the absence of any too great enthusiasm at the time—that memory will always remain one of the most cherished ones. Without the co-operation of dozens of very dear friends, who are so well known to you that it is unnecessary to mention them—the suggestion would have remained only a bright thought instead of growing into a splendid reality. But at least I want to claim the credit of being a good guesser, if not a prophet. One needs to be neither, however, to be able to foretell the still more promising future of the Society.

It was my good fortune to traverse some 10,000 miles and visit fifteen or twenty states within the last six or seven months, in the cause of social health insurance. The rapid growth of the movement for early action amazed even me, an old enthusiast or even fanatic on this subject. I cannot help feeling certain that in some form, action will be taken from now on at a rapidly accelerating rate. I venture to prophesy that problems of social insurance will acquire a dominating place in our deliberations. I venture to prophesy that from now on members of our Society, some of whom may not yet suspect it, will take a growingly important part in solving the problems, mathematical, statistical and legislative, of

social insurance and I venture to prophesy further that from now on, and during the next decade or two, the development of sickness, invalidity, old age, unemployment and survivors' insurance will swell the membership and importance of our Society beyond the wildest dreams of those who were responsible for the initial steps in its organization; until the C.A.S.S.A. will gain for itself a very prominent position indeed, not only in the hierarchy of purely scientific organizations, but what I venture to submit, is even more important, as an institution which can and will apply the scientific methods of mathematics and statistics to the elimination of grave social ills, and to the betterment of the world we live in.

From the distance of three thousand miles I wish you with all my heart, a successful meeting, and hope that it shall be the last one that I will miss for many years to come.

A Suggestion for a Modified Form of Amortization with a Brief Memorandum of the Applicability of that Principle to the Bonds of Miscellaneous Companies.

BY

S. HERBERT WOLFE.

As long as bonds are bought above or below par the properly managed insurance company must have recourse to some form of amortization or accumulation. Unfortunately the present method, although it is the one used in text books and prescribed by the laws of some of the states (see § 18 of the Insurance Law of the State of New York), is based upon hypotheses which never exist and in consequence produce theoretical results only. I am sure that this thought must have occurred many times to those who have considered the question of investment accounts, and the object of this paper is merely to suggest a form of relief for insurance companies.

To demonstrate the incorrectness of the present method, let me briefly review the operations now followed in preparing a schedule of amortization for a bond bought above par.

After examining the bond to determine its nominal rate of interest (i) and the number of years it will have to run to maturity, we attempt to find the effective interest rate (i') by locating its purchase price in a book of bond values; this book is constructed as follows:

TABLE I.

	i.		
	First Period.	Second Period.	Third Period.
i'	$P+\frac{Pi-Pi'}{1+i'}$	$P+\frac{Pi-Pi'}{1+i'}+\frac{Pi-Pi'}{(1+i')^2}$	$P+\frac{Pi-Pi'}{1+i'}+\frac{Pi-Pi'}{(1+i')^2}+\frac{Pi-Pi'}{(1+i')^3}$

In which P is the principal of the bond.

This is the mathematical basis of a bond value book, part of a a typical page of which will be recognized in the following form:

VALUES, TO THE NEAREST CENT, OF A BOND FOR $1,000,000 AT 4 PER CENT. INTEREST, PAYABLE SEMI-ANNUALLY.

Net Income.	½ Year.	1 Year.	1½ Years.	2 Years.	2½ Years.
2.50	$1,007,407.41	$1,014,723.37	$1,021,949.00	$1,029,085.43	$1,036,133.76

After locating the proper nominal rate at the top of the page we enter the column corresponding to the length of time the bond has to run; when we find the purchase price, we will have obtained the effective interest rate, which will be the figure appearing in the column at the extreme left of the page. In actual practice the method is not quite so simple for two reasons:

(*a*) Unless the bond is bought on a coupon date its maturity period will not be a multiple of six months.

(*b*) It is unusual to have the purchase price agree exactly with the table.

It is necessary, therefore, to make an approximation to allow for these variations from the normal. This having been done a schedule is prepared upon the assumption that the investor will receive only the effective rate (i') upon the investment and the balance of each payment received from the debtor is to be used to extinguish the premium. Indicating the amortization factor by A, we have

$$A = Pi - Pi'.$$

In other words, the wiping out of the premium will require us to use some part of each coupon payment, the amount depending upon three factors—the principal, the nominal rate and the effective rate—the first two of which may be termed fixed quantities as they are unaffected by the price at which the security is bought. The value of i', however, fluctuates inversely to the premium, for as the latter becomes greater i' becomes smaller.

Let us now consider three lots of bonds all purchased at the same time, having the same par value—$1,000,000—and bearing 4 per cent., 4½ per cent. and 5 per cent. respectively, interest payable semi-annually and all maturing in ten years. The purchase price and the consequent effective interest rates are shown in the following schedule:

TABLE II.

Lot.	Purchase Price.	Effective Interest Rate.
1	$1,131,944.87	2.50%
2	1,128,764.79	3.00%
3	1,125,646.61	3.50%

On each coupon date $20,000 will be clipped from lot 1, $22,500 from lot 2 and $25,000 from lot 3, which amounts will be divided into two parts, one being carried to the interest earnings and the other set aside to accumulate at its own particular i' rate so that at the maturity date it will extinguish part of the premium. This division will be as follows:

TABLE III.

(1) Lot.	(2) Interest Factor.	(3) Amortization Factor.	(4) Effective Interest Rate
1	$14,149.32	$5,850.68	2.50%
2	16,931.47	5,568.53	3.00%
3	19,698.81	5,301.19	3.50%

It must be borne in mind that all of the amounts shown in column (3) are received at the same moment, that they must be reinvested the instant they are received and the amount from each lot must be used to purchase securities which will yield its effective rate shown in column (4). If all of those conditions are not complied with, the premiums on the different lots will not be extinguished scientifically.

In actual practice it is impossible to reinvest immediately and it is absurd to consider that each different instalment of A will be so invested as to produce a different i'. Both are purely theoretical assumptions.

Why should we not assume a condition which will harmonize with the actual situation and take cognizance of the fact that all of the A items received at the same time will be invested to earn the same rate of interest, irrespective of their origin. The present method does not give correct results and requires the preparation of a special amortization schedule for each lot of bonds purchased. (The present conditions of the bond market whereby good securities earning high rates of interest are selling below par, are materially increasing the difficulty in the preparation of the schedules.) Why not adopt some method which will involve no more serious error and which will permit the use of a standard table applicable to all bond issues without regard to their nominal interest rates and dealing only with the purchase prices. That would be accomplished if we extinguished the premium of a bond by means of an annuity certain, the rate of which (i_x) could be agreed upon and the rent of which (r) would be a substitute for A and therefore

$$Pi' = Pi - r.$$

The plan is feasible if we can assign a proper value to i_x. If a company's average interest rate remain constant year after year, the solution would be simple, but even in the best managed companies there is an annual variation due to change in the supply of investment capital in the money market or a change in the form of securities purchased or a change in some of the many other factors entering into the management of the investment department. However, by taking the average interest rate earned during the past five years, conservatively adjusted with an arbitrary factor to allow for the rising or falling tendency, we can obtain i_x sufficiently correct for all practical purposes.

After fixing upon i_x the next step would be to construct a table of the amount of an annuity of 1 for the various n periods by using the formula

$$\frac{(1+i_x)^n - 1}{i_x}.$$

Let us assume an average annual earning power of $4\frac{1}{2}$ per cent. A specimen table constructed by means of the formula just given will be

TABLE IV.

AMOUNT OF AN ANNUITY CERTAIN FOR VARIOUS PERIODS AT $4\frac{1}{2}$ PER CENT. PER ANNUM, PAYABLE SEMI-ANNUALLY, SEMI-ANNUAL RENT $1.

Period.		Period.		Period.		Period.	
½ yr.	1.	13 yrs.	34.81731628	25½ yrs.	93.79966416	38 yrs.	196.67350941
1 "	2.0225	13½ "	36.60070590	26 "	96.91015661	38½ "	202.09866337
1½ yrs.	3.06800625	14 "	38.42422178	26½ "	100.09063513	39 "	207.64588329
2 "	4.13703639	14½ "	40.28876677	27 "	103.34267442	39½ "	213.31791567
2½ "	5.23011971	15 "	42.19526402	27½ "	106.66788460	40 "	219.11756877
3 "	6.34779740	15½ "	44.14465746	28 "	110.06791200	40½ "	225.04771407
3½ "	7.49062284	16 "	46.13791226	28½ "	113.54444002	41 "	231.11128763
4 "	8.65916186	16½ "	48.17601528	29 "	117.09918992	41½ "	237.31129160
4½ "	9.85399300	17 "	50.25997563	29½ "	120.73392169	42 "	243.65079560
5 "	11.07570784	17½ "	52.39082508	30 "	124.45043493	42½ "	250.13293857
5½ "	12.32491127	18 "	54.56961864	30½ "	128.25056972	43 "	256.76092967
6 "	13.60222177	18½ "	56.79743506	31 "	132.13620754	43½ "	263.53805069
6½ "	14.90827176	19 "	59.07537735	31½ "	136.10927221	44 "	270.46765674
7 "	16.24370788	19½ "	61.40457334	32 "	140.17173083	44½ "	277.55317902
7½ "	17.60919130	20 "	63.78617624	32½ "	144.32559477	45 "	284.79812555
8 "	19.00539811	20½ "	66.22136521	33 "	148.57292066	45½ "	293.20608337
8½ "	20.43301957	21 "	68.71134592	33½ "	152.91581137	46 "	299.78072025
9 "	21.89276251	21½ "	71.25735121	34 "	157.35641713	46½ "	307.52578645
9½ "	23.38534966	22 "	73.86064161	34½ "	161.89693651	47 "	315.44511665
10 "	24.91152003	22½ "	76.52250605	35 "	166.53961758	47½ "	323.54263177
10½ "	26.47202923	23 "	79.24426243	35½ "	171.28675898	48 "	331.82234099
11 "	28.06764989	23½ "	82.02725834	36 "	176.14071106	48½ "	340.28834366
11½ "	29.69917201	24 "	84.87287165	36½ "	181.10387705	49 "	348.94483139
12 "	31.36740338	24½ "	87.78251126	37 "	186.17871429	49½ "	357.79609010
12½ "	33.07316996	25 "	90.75761776	37½ "	191.36773536	50 "	366.84650213

The foregoing table and similar ones for the various interest rates which will be required have been worked out and may be found in standard text-books.

It should be borne in mind that "4½ per cent." in the heading of the table is the i_x we will use to extinguish the premium. Its application to the three lots of bonds previously referred to is as follows:

Lot 1—Premium to be extinguished	$131,944.87
Amount of semi-annual rent of $1 from table (20 periods)	24.91152003
Semi-annual rent of an annuity whose amount is $131,944.87	5,296.54
Therefore the semi-annual coupon payments of $20,000 will be divided into	
Interest factor	14,703.46
Amortization factor	5,296.54
Lot 2—Premium to be extinguished	$128,764.79
Amount of semi-annual rent of $1 from table (20 periods)	24.91152003
Semi-annual rent of an annuity whose amount is $128,764.79	5,168.88
Therefore the semi-annual coupon payments of $22,500 will be divided into	
Interest factor	17,331.12
Amortization factor	5,168.88
Lot 3—Premium to be extinguished	$125,646.61
Amount of semi-annual rent of $1 from table (20 periods)	24.91152003
Semi-annual rent of an annuity whose amount is $125,646.61	5,043.71
Therefore the semi-annual coupon payments of $25,000 will be divided into	
Interest factor	19,956.29
Amortization factor	5,043.71

It will be noted in the above that we have used the same factor for the amount of the annuity—24.91152003—for all of the lots, notwithstanding that the bonds bore different interest rates. A comparison of the results of the present method of amortization and those obtained by the use of the proposed method is shown in the following table:

TABLE V.

Lot.	Semi-annual Interest Earnings.		Semi-annual Amortization Factor.	
	Present Plan.	Proposed Plan.	Present Plan.	Proposed Plan.
1.....	$14,149.32	$14,703.46	$5,850.68	$5,296.54
2.....	16,931.47	17,331.12	5,568.53	5,168.88
3.....	19,698.81	19,956.29	5,301.19	5,043.71

Instead of using, therefore, a bond value book with values applicable only to certain interest rates, we need have only one table which will answer for all rates and which will give more accurate results as they will be logical and based upon assumptions representing the actual investment conditions.

It is unnecessary to burden this suggestion with any examples of bonds purchased below par for the same method will be followed, but it would appear to me that the proposed method will be more nearly correct in that the discount factor will be accumulated not at an artificially high rate of interest caused by unusual conditions, but at a rate which more nearly conforms to actual conditions.

It will be apparent that this suggestion will not affect the actual interest earnings of the company, but since it deals with a readjustment in the distribution as between effective interest factors and amortization (or accumulation) factors, it will have a bearing upon the rate used in dividend assumptions and similar calculations.

To summarize: The advantages of the proposed method are

First—It requires the use of only one table, which is applicable to all bonds, irrespective of their nominal interest rates.

Second—It overcomes the difficulties due to the inability of finding bond tables for high nominal rates at prices below par. Some of the earlier publications of bond tables did give such values, but used only two or three decimal places, the resulting error being considerable on large purchases or sales.

Third—It eliminates the illogical assumption that interest installments received at the same time are so invested as to earn different rates of interest.

Fourth—It permits of an easy adjustment if at any future time it should be deemed advisable to use a different i_x.

I fully realize that objections may be urged properly against this proposed plan, but it seems to me that they are outweighed by the advantages. It is interesting to note the discussion by Mr. L. P. Orr of the very excellent paper on the amortization of bonds by Mr. Henry Moir, which appears in the *Transactions* of the Faculty of Actuaries, Vol. VII, p. 171. In discussing the advantages of the amortization plan and the market-value plan, Mr. Orr stated at page 198:

"Now, Sir, I do not wish my remarks to be regarded as unduly commending or depreciating either Method of Valuation. Each has its merits and its defects. Indeed I have long ago come to the

conclusion, that up to the present time, no method has been put forward that is not open to objection: and I almost doubt the ability of our profession to produce one that will receive the general approval of Actuaries throughout the world. The Amortization Plan has rather gone out of fashion in the United Kingdom. On the other hand, the Market Price Method is being ousted in the United States, and is not in favor in Australia or South Africa; while in Canada, although it is the legal basis, the Amortisation Plan is used for certain Bonds, and one large Company recently announced its completion of the adoption of that plan to its investments."

II.

It may be correctly stated, I think, that the amortization plan is of prime importance to life insurance companies, for their contracts are entered into for a long period of years and it is difficult to conceive of a situation which would require their securities to be converted into cash upon short notice. That the question of investments, however, is an important one to the so-called "miscellaneous" companies as well as to life insurance companies, is well illustrated by some tables which were prepared by Miss Katherine M. O'Leary, of the Massachusetts Insurance Department. Table VI shows the investment profit as compared with the underwriting profit or loss for the year 1915 exhibited by the statements filed by ten of the largest companies with insurance departments:

TABLE VI.

Company.	Profit from Investments.	Profit from Underwriting.	Loss from Underwriting.
A.....	$521,864.64	$254,013.13	
B.....	395,572.74	294,606.69	
C.....	209,581.91	361,074.90	
D.....	304,112.00	297,656.65	
E.....	109,678.06		$231,585.69
F.....	270,097.85	193,683.75	
G.....	257,258.85		54,640.51
H.....	152,703.37	200,832.54	
I.....	138,846.88	128,602.45	
J.....	216,406.91	72,522.27	
	$2,576,123.21	$1,802,992.38	$286,226.20

Since it is apparent that "miscellaneous" companies relied upon their securities for so large a percentage of their profits, it is interesting to note how the investments of those companies were distributed:

TABLE VII.

Company.	(a) Government, State or Municipal Bonds.	(b) R. R. Bonds Running 10 Years or Less.	(c) All Other R. R. Bonds.	(d) Miscellaneous Bonds.	(e) Stocks.	(f) Mortgages.	(g) Total Investments.
A.....	$ 699.858	$359,380	$4,191,985	$387,350	$3,690,762		$9,329,335
B.....	1,645,614	292,000	1,798,250	444,550	1,806,141	$268,977	6,255,532
C.....	4,049,296	787,680	450,280	307,500	504,726	22,750	6,122,232
D.....	4,030,831	619,400	2,504,000	315,000			7,469,231
E.....	2,069,591	200,050	1,351,617	457,025	325,507	142,343	4,546,133
F.....	1,418,373	216,728	1,473,610	163,435	721,050	1,448,245	5,441,441
G.....	3,953,448	32,500	171,890	409,900		130,650	4,698,388
H.....	1,093,292	452,860	2,183,370	241,500		4,500	3,975,522
I.....	1,583,710	156,870	1,637,221	63,980			3,441,781
J.....	827,760	1,077,650	2,796,830	223,000		123,000	5,048,240
	$21,371,773	$4,195,118	$18,559,053	$3,013,240	$7,048,186	$2,140,465	$56,327,835

This table indicates how large a percentage of the investments are in securities which would ordinarily be subject to some method of amortization, and we must consider, therefore, the advisability of so treating the investments of companies issuing policies of insurance, the nature of which may require the payments of large sums upon short notice. In some states amortization for miscellaneous companies is sanctioned by statute, and the pertinence of this inquiry is emphasized. In the event of a catastrophe it would become necessary to effect a quick liquidation of assets if the companies did not protect themselves in some way; this protection is secured in different ways. Some companies guard against the catastrophe hazard by reinsuring part of each risk: others reinsure only when the amount at risk exceeds a limit which they have established as a safety point: others are members of a mutual "reinsurance pool" to which each subscriber contributes a percentage of the premiums received and the pool agrees to assume the liability for any payments in excess of a stated loss which may result from a single contingency. This last method has been in successful operation for some time and the number of demands made upon the funds of those "pools," with the operations of which I am familiar, has been surprisingly small.

The grouping of the different forms of "miscellaneous" business may be summarized as follows:

Group 1. Consisting of those branches which are subject to catastrophes.

Group 2. Those branches which are free from that possibility.

Group 1.	*Group 2.*
Personal accident.	Health.
Workmen's compensation.	Liability (policy containing limits).
Plate glass.	Fidelity.
Workmen's collective.	Burglary and theft.
Unlimited liability.	Automobile and teams property damage.
	Surety.

It will be noted that credit insurance has been omitted from both of the foregoing groups, for while credit policies contain a maximum limit of liability and therefore the element of catastrophe is absent from *each* contract, a severe financial depression may produce a "catastrophe" hazard in that a large number of policies will develop claims which in normal times would not exceed the initial loss limit.

The catastrophe hazard in personal accident insurance is illustrated by a recent occurrence when all of the members of a fraternal organization bound for a convention in a distant city were insured against travel accidents by an insurance company; unfortunately the train was wrecked and a number were killed.

Workmen's collective policies may be considered as group accident insurance policies, and as such are subject to the possibility of single accidents involving a number of claims.

In considering the advisability of applying the principle of amortization to the bonds of a miscellaneous company it should be borne in mind that no company transacts only one of the lines shown in groups 1 and 2; multiple lines are the rule and in consequence the danger to a company of extinction by a catastrophe is minimized greatly.

The possibility of requiring funds for reinsurance purposes presents the only other factor which would require sudden conversion of assets into cash, but even this situation might be met if in cases of reinsurance the company assuming the risks would be permitted to carry the assets given as the reinsurance consideration at the same amortized figures used by the ceding company. That this method would be practicable was demonstrated in the case of a merger of two companies recently in a western state; at the request of the insurance commissioner I prepared the schedule of assets and liabilities and took the position that although the merged

company was a new corporate entity, no logical reason existed for considering that the assets had been sold; the new corporation, therefore, was permitted to carry the bonds at the same figures as its two constituent parts did before the amalgamation.

Although the principle of amortization has heretofore been applied in a very limited degree to the assets of miscellaneous companies, I am of the opinion that with existing safeguards against catastrophes, we may safely amortize the bonds of such companies.

SCHEDULED EXPERIENCE RATING.

BY

ALBERT H. MOWBRAY.

It will be obvious to the members of this Society that no adequate test of the theory herein advanced could be made from the data available in the records of any one company. Hence the writer cannot say positively that it will be found in practice an improvement on that now followed or that it will be found workable at all. Yet it would seem to be the duty of members of this Society to bring before it for discussion and criticisms such studies, when made in the hope that if found apparently practicable a method of test will be found. It is in this spirit that the following study is presented.

Present methods of compensation rate-making have been subjected to criticism at two points of their progress. The methods of determining manual or base rates have been several times directly criticized as employing too much subjective judgment and as being too inflexible to meet changing conditions such as the rise and fall of accident frequency with changes in industrial activity. The method of modifying classification rates through rating schedules has by implication been subjected to equal criticism through criticism of the similar fire-rating schedules, as resting entirely on personal judgment for their values and as inconsistent and inharmonious with classification rates made from experience.

Personal judgment has entered into the making of manual rates through the insufficiency of experience data to furnish dependable pure premiums for the several classifications. It has been suggested that the number of classifications is too large and that this results from a wrong principle of classification. This is a question for further consideration and discussion. The practical field men and executives seem to feel the present basis needful. The disturbing effect upon classification experience limited in volume, of one or more serious or fatal accidents, is also a cause for the use of judgment in modifying statistical indications.

Little time need be taken for a discussion of present methods of

modifying statistical indications in determining manual rates—a process of association with cut and fill leveling according to the combined judgment if not the whim or prejudice of the rate making committee checked back by a comparison of actual and projected losses. Massachusetts and New York Insurance Departments are now calling for a separate return in Schedule Z of fatal accidents in the hope that such data may be helpful in the effort to spread the cost of this type of accident, especially when it is not characteristic of the industry. While such data will undoubtedly be useful in such work, it of itself furnishes no rule for its use, which must still be governed by subjective judgment so called.

We can hardly get away from the criticism of inflexibility for some time to come, our rates must be made for the future from the data of the past with all the limitations thereby imposed of waiting for payroll audits and maturing of experience and of even then working with data more or less vitiated by the necessity of including estimates of deferred liability on serious cases. The suggestions herein put forth are not intended or expected, except incidentally, to meet this criticism.

Turning to implied criticisms, our present rating schedules largely follow in form those in use for fire insurance rating. These fire-rating schedules were developed for application to a base rate made solely upon personal judgment for an arbitrary type of risk having no necessary relation to any found in practice. The values assigned to the individual schedule items were also purely personal judgment values, though in fairness it must be said that the judgments were of men of broad experience with large opportunity for observation. The base rate for the arbitrary type from which the schedule departures are taken is made in the same way. To this extent the system is consistent. But it is now proposed to try to base fire insurance rates on pure premiums derived from classified statistical experience records and a fire underwriter of no less standing than Mr. E. G. Richards, U. S. manager of the North British and Mercantile Insurance Company and lately president of the National Board of Fire Underwriters has pointed out the inconsistency of attempting to combine individual rate modification according to schedules of this type with classification base rates so made. In the "Experience Grading and Rating Schedule" he proposes a new system, which has suggested to the writer the present study.

Our present workmen's compensation rating schedules were doubtless inspired by the existing fire schedules which seem to have been taken as a model. The values are likewise judgment values applied directly to the rate. They do not specify any definite standard underlying the base rate which, however, is assumed to be an average risk. This further complicates matters, for the average rarely, if ever, exists in actual life. It is purely a mental concept, a composite photograph of what has come into the range of observation. A statistical average is perhaps not too hard to deal with, since by analysis we can determine its composition but where the average has not been determined from actual statistics the problem becomes exceedingly complex, since each individual has his own impression based upon recollection of conditions he has observed. Hence have arisen the conflicts of opinion over the propriety of credits for certain conditions in place of charges for the lack of them.

As progress is made in safety work the average is presumably raised and the experience pure premium ought to reflect this. Hence by change of the base line the schedule values will be thrown out of line and conditions now covered by credits should probably be required, their absence calling for charges.

It would seem there is an irreconcilable conflict between our present system of manual rate determination and our present schedule system of individual rate modification.

For these faults in our present methods what are the remedies? It is obvious that much of the direct criticism can be met if a way can be found to broaden the range of our observation so as to give us a larger exposure basis of rate-making. It is hard to see how the criticisms of our rate modification plans can be met except by a radical change in system.

Obviously an increased exposure would be obtained if our rate-making data were based upon a longer term of observation. This, however, is open to serious objection for several reasons, among the most important of which are:

1. Increasing cost due to more complete report of the compensation benefits.
2. Changes in costs resulting from changes in business conditions (not in all respects an objection).

3. Changes in legal terms and administrative methods having important effects upon costs but difficult to measure with precision.

An increased exposure would also result if data from a larger area were brought into requisition. To this proposal also serious objections may be raised. Among the conditions adversely affecting such a proposal are:

1. Difference in legal conditions in different states necessitating the use of differential multipliers, the accuracy of which may easily be called in question.
2. Differences in local administrative methods which cannot be measured satisfactorily by a differential.
3. Differences in local conditions due to differences in the type of working population.
4. Local differences in methods of conducting similar operations due to climatic or other differences in condition.

It has been attempted to secure a larger rate-making base by combining classifications in groups by analogy of hazard and the use of multipliers where necessary. The amount of gain possible in this way is quite limited and discussions which have taken place here and elsewhere have raised serious questions which need not be reviewed here.

Study along the line of Mr. Richards' suggestions in regard to fire-rating has led the writer to a further suggestion which seems to have considerable possibilities of usefulness. For lack of a better term we will refer to it as analyzed combination in groups.

Various analyses of the pure premium formula $\pi = L/P$ have been presented. The analysis

$$\Pi = \frac{L}{P} = \frac{l_1 + l_2 + \cdots + l_w}{P} = \frac{l_1}{P} + \frac{l_2}{P} + \cdots \frac{l_w}{P}$$

is simple and obvious, the losses being divided into elements according to the point of view of the study. It is proposed to approach the problem from the point of view of hazard or accident cause. The analysis indicated above may be carried as far as desired. For present purposes it is sufficient to stop after analyzing to one of a few simple groups of causes, for which analysis sufficient data

is usually available in the first accident report without further investigation. The following is suggested as a tentative set of groups:

1. Power generation including boilers, engines, etc.
2. Power transmission covering to the belt of the individual machine.
3. Working machinery.
4. Hand and portable tools.
5. Conditions of building, stairs, floors, etc.
6. Elevators.
7. Electric hazard.

If this or a similar set of groups were used and an analysis made as indicated above we would find our pure premium break down into a number of parts, each representing, if the exposure were sufficient, the pure premium for coverage of accidents only from the corresponding group of causes. Of course if insurance were to be actually written in this way we would need to find some other basis of premium than the entire payroll of the plant. It is not so written and division of payroll along such lines is impracticable, so that we must use the entire payroll for the denominator of the fraction and in so doing the analysis is not for present purposes vitiated.

The writer has not been able to make such an analysis and he doubts the value of it unless made on a broad basis but it seems highly probable that with studies based upon sufficiently broad exposure it will be found that the sectional pure premium for certain hazards, say elevators for example, will be found substantially the same for a wide range of classifications which as a whole could not possibly be combined.

If this be so it would violate no principle of equity to determine this part of the pure premium for each classification from the combined data of such enlarged group. Offhand, it is hard to see why there would be need of further subdivision for determining the elevator hazard section of the workmen's compensation pure premium than for determining pure premium for elevator public liability coverage.

Such determination of sections of the pure premium from the broadest possible basis of combined classifications would of itself tend to distribute the weight of fatal and serious accidents not

fundamentally characteristic of the classification, thus meeting one criticism of the present method, the one which has led the insurance departments to call for segregated returns of fatal accidents. To the writer, such a method would seem to be more rational than to study and attempt more or less equitably to adjust the fatal accident cost shown by such special returns.

The use, if practicable, of enlarged groups for determining sectional pure premiums has also a further and greater advantage in permitting of subdivision and analysis along new lines leading to a readjustment of our schedule rating plans to make them more consistent with our system of determining pure premiums from experience.

We have already pointed out some of the disadvantages of trying to frame schedules for use in comparison with an average as the base. Others have pointed out the greater simplicity of making a schedule upon either an ideal standard, the departures being wholly charges, or the worst possible risk as the base, all departures being credits. Either of these bases might be used as the starting point if the purpose were merely to arrange all risks in order of merit, that is if the schedule were merely a grading schedule. Much of the dispute among engineers and underwriters in making schedules has arisen either over the question whether a given condition was better or worse than the average, or whether a condition required by the law of some state should carry a credit, or some similar question arising out of the fact that the schedule was a rating schedule. There seems to be little difficulty in reaching agreements that certain conditions are better than others and even agreeing how much better. Therefore the construction of a grading schedule would seem to be a much simpler task, especially if it were confined to a particular section or type of hazard, when it is not necessary to inquire whether for example a certain improvement in the power generation hazard were less or more valuable than a certain other improvement in the working machine hazard.

Let it be assumed then that it is possible to constitute a large group of classifications for which the elevator hazard, for example, is substantially the same and for which a very large payroll exposure can therefore be observed. Let it be further assumed that a grading schedule for the elevator hazard had been worked out and all the risks in the group had been classified according to grade in ten (or a lesser number) grade classes. Let it be finally as-

sumed that payrolls and losses due to elevator hazards have been correspondingly tabulated. We would have, combining all the data, an average pure premium for the elevator hazard which we may call X; we would also have, taking the data for each class separately, a series of class pure premiums for the elevator hazard which we may call X_1, X_2, X_3, etc. If we take the quotients X_1/X, X_2/X, etc., we will find the percentage which the cost in each class bears to the average cost represented in the manual rate. From these the amount of charge or credit to be given risks which the grading schedules place in the several respective grades may be readily determined. These credits or charges will be subject to revision when additional data is available as and when basic manual rates are revised.

It is believed that for all of the sectional pure premiums except those dealing with the characteristic working machinery of the several classifications, enlarged groupings will be possible, giving sufficient payroll exposure to permit of this kind of study. Further, the segregation of the other elements would leave only a part of the premium, which it would seem must be determined by the experience of the classification itself or of analogous classifications. Hence an error in association by analogy would have less weight than where the entire premium was so determined and we would feel more free to make such combinations, thus getting larger payroll exposures here. Finally, study of the percentages for the several grades for working machine hazard in those classifications where ample data did exist would doubtless show very approximately what should be the proper credit and charge for the several grades.

The statistical work involved will not be very difficult and is well adapted to the use of perforated cards. It will, of course, be necessary to record on the exposure card the grade in the several hazard sections received by the risk in question and on the accident card the hazard section in which the cause of the accident falls and the grade received in that section by the risk reporting the accident. The tabulations required have probably been sufficiently indicated above. There are appended to this paper, cards adapted from those now used by many of the companies which it is believed would suffice for the purpose, assuming exposure cards are not made until audit has been completed.

Enough has probably been said above to indicate fairly clearly

how rates would be made according to this theory but perhaps it may serve to clarify and fix the idea to briefly recapitulate the several steps.

1. For suitably associated large groups of classifications the several sectional average pure premiums are to be determined. (Note: The groups may and probably should vary for the several hazard fields or sections.)

2. For the same groups the percentage credits and charges for the several grades are to be determined.

3. The manual classification pure premium will be found by adding the several sectional or partial pure premiums found for the corresponding hazard field for the group in which it was placed.

4. The individual risk is to be graded according to the schedules for the several hazard fields and the credit or charge as a percentage of the manual rate will be found by adding together algebraically credits or charges on each hazard field (these being the proper percentages of the corresponding pure premium) and finding the ratio of this sum to the manual classification pure premium.

There remains to be considered the management or so-called moral or, as it seems more appropriately termed, "morale" hazard. It will be readily seen that this item cannot enter additively into the synthesis either of the manual or the individual rate. On first consideration, however, it would seem entirely proper to formulate a grading schedule for this element also and combine the entire experience in large groups of accident cost from all causes. Then do the same for the several management hazard grades and so determine the percentage of credit or charge to be applied to the manual rate. The writer could find no fault with this proposal if he felt there were probably no correlation between physical condition and management or morale hazard. On the contrary, however, it seems reasonable to believe there is a close correlation. This greatly complicates the matter though it is fair to say that this complication arises from the same reason with all plans of schedule rating.

It would seem that a study of the extent and nature of this correlation should be made before attempting to modify rates on account of this element. Some indication of the nature and degree of correlation would appear to be given if risks were graded for morale and the average grading on physical condition determined for each grade on morale. It might be that the proper multiplier

on this account would be indicated by comparing the total actual losses for the risks in a given morale rank with the total projected losses assuming the average physical rating.

It may be noted in closing the presentation of the foregoing theory that under it the vexatious problem of whether application of the schedule will raise or lower rates and how much will not present itself. Manual rates so constructed automatically work out to reproduce the experience upon which they were made and the individual adjustments will automatically balance.

It will be evident that it will not be possible immediately to put into effect in its entirety a system of grading and rating such as the above. A period of transition is necessary during which data is being collected on which to work, particularly for determining the charges or credits to correspond to grading results. If broken into hazard sections the present rating schedules may serve as the basis of grading schedules and it seems not improbable that the results of their application would grade risks into ranks not very different from those into which they would fall under the operation of schedules constructed solely for grading. If this be so we might at once proceed upon the statistical work, maintaining the present schedule rating plans until the grading credits have been worked out.

It may be objected that a system of rating such as is worked out herein would be less acceptable in the field because the broker or agent would be less able to advise the insured in regard to improvements in his plant and the effect of changes on rates. It should be noted that when the plan was put into operation grading schedules would be published as would the credit for each grade. An inspection of the plant would show present grades and a study of deficiencies noted and their weight in the schedule would show how the grade could be improved and the credit thereby gained. The broker or agent would thus be no worse placed than at present.

It is not hoped that the above theory will be found entirely free from practical objection nor that it can be adopted in its entirety as above set forth. It is hoped that it may lead to further study and perhaps statistical work looking to the development of a consistent system of manual and individual rate making. In closing, indebtedness must again be acknowledged to Mr. E. G. Richards through his book "The Experience Grading and Rating Schedule" for suggestion of the central idea above presented, without however

Designating Number	State	Issue	Class'n	Audited Pay Roll Dollars Only	Earned Premium		Gradings Field of Hazard										Morale	
					Dollars	Cents	1	2	3	4	5	6	7	8	9	10		
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EXPOSURE CARD.

Designating Number	Grade (1 2 3 4 5 X / 6 7 8 9 10 X)	State	Issue	Class'n	Acc Date (Yr. Y X / Mo. Y X)	Sex.	% Impt.	Medical Paid (X Dols. / Cts.)	Manner of Occurrence	Cause of Injury (Y X)	Nature of Injury (X X)	Weekly Wage	Duration of Injury (Kind / Weeks / Days)	Compensation Paid (Kind of Payt. / Dollars / Cts.)	Morale
0	0 0 0 0 0 0	0 0	0	0 0 0 0	0 0	M	0	0 0 0 / 0 0	0	0 0 0	0 0	0 0	0 / 0 0 0 / 0	0 0 / 0 0 0 0 / 0 0	0
1	1 1 1 1 1 1	1 1	1	1 1 1 1	1 1	1	1	1 1 1 / 1 1	1	1 1 1	1 1	1 1	1 / 1 1 1 / 1	1 1 / 1 1 1 1 / 1 1	1
2	2 2 2 2 2 2	2 2	2	2 2 2 2	2 2	2	2	2 2 2 / 2 2	2	2 2 2	2 2	2 2	2 / 2 2 2 / 2	2 2 / 2 2 2 2 / 2 2	2
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4	4 4 4 4 4 4	4 4	4	4 4 4 4	4 4	4	4	4 4 4 / 4 4	4	4 4 4	4 4	4 4	4 / 4 4 4 / 4	4 4 / 4 4 4 4 / 4 4	4
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ACCIDENT CARD.

in any way disclaiming responsibility for the form and manner in which it has been presented for application to workmen's compensation insurance rate making.

It has been the aim to modify the present cards in general use as little as possible. The accident card may be greatly simplified if it is not desired to use it for other purposes as now designed. It is probable that the "Cause of Injury" Code may be so developed that the first column can be used to designate the hazard field to which the accident is to be assigned. It then only becomes necessary to provide for recording the grading in regard to that field, which is done by using the at present unused portion of the first field, and for the morale grading, which is done by using the last column on the card. The "x" or "y" of this column may be used as the counter if it cannot otherwise be provided for.

NOTE.

Since the above was prepared and transmitted to the Society the writer has learned from Mr. Richards that he is now engaged in preparing a revised edition of his Experience Grading and Rating Schedule. It would, therefore, seem that if casualty insurance is to derive the greatest benefit from his studies and suggestions we should not close our consideration of the subject until this becomes available.

In this connection it may not be inappropriate to point out that the student of one field of economic science who sees in the practical suggestions of a student of a kindred field the enunciation of principles which may help solve his own problems, is in a somewhat delicate position. Loyalty to his own work would seem to compel him to direct attention to such principles and suggestions and to try to suitably adapt them to the special needs of his own field. In so doing, however, fairness demands that due credit be given to him who first gave them out. Yet unskillfull attempts at adaptation may prove an impediment to the clear understanding and appreciation of the value of the original suggestions and thus develop unwarranted opposition to their adoption in their own field. The writer would deeply regret his action in presenting his paper at this time if such results should follow in the present instance. Having this in mind he strongly urges all whose interest may have been aroused by the foregoing to familiarize themselves with Mr. Richards' work itself and form their judgment of its value on its individual merits.

SOME PRINCIPLES OF COMPENSATION MERIT RATING.*

BY

E. H. DOWNEY.

Merit rating, as applied to workmen's compensation insurance, is designed both to secure a closer approximation of rates to the hazard of the individual establishment than is afforded by the class rate, and to stimulate accident prevention. These objects are trite enough; what has been less generally recognized is that the two are not wholly compatible. Both, indeed, have to do with hazard measurement; the difference lies in the premium value attached to specific hazards or hazard indicia. From the standpoint of accurate rate adjustment, hazard should evidently be measured in terms of accident cost and the resultant charge imposed without regard to preventability. For the purpose of accident prevention, on the contrary, the penalties should be confined to accident causes within the employer's control and should be sufficient in amount to induce the elimination of the hazards in question. The contrast is most clearly seen in the treatment of what may be termed fixed plant conditions—fixed in the sense that no graduation of accident insurance rates will bring about their alteration. The use of steam boilers and engines, or of line shafting and belt drives, the occupancy of loft manufacturing buildings, or the presence of faults, pot holes and draw slate in the roof of a coal mine, are hazards not common to all establishments within the same industry class,

* The writer was favored with copy of Mr. Mowbray's manuscript on "Scheduled Experience Rating" (*Proceedings*, Vol. III, p. 14) while this paper was still in course of preparation. Mr. Mowbray's proposals partly anticipate, partly traverse, those herein suggested. Both indeed, aim at the same result: a schedule rating system founded upon accident statistics. Nevertheless, it has seemed worth while to publish the present paper, in the hope of eliciting further discussion.

The extent of the writer's indebtedness to the coal-mine rating schedule of the Associated Companies will be evident to all who are familiar with that schedule. Valuable suggestions were also received from Mr. G. C. Kelly of Philadelphia, Pa., who has prepared a very thoughtful paper on somewhat similar lines.

and hence properly chargeable for the purpose of rate adjustment, though it is obvious that no accident insurance charges will induce the abandonment or reconstruction of the plants wherein such conditions occur. Merit rating for the sake of accurate rate adjustment would make much of these and the like conditions; merit rating for accident prevention would ignore them altogether.

Since both prevention and rate adjustment are professed objectives of all merit rating, and since these objectives diverge in the manner above spoken of, every merit rating plan requires to be evalued from both standpoints. It might be urged, indeed, that prevention is no concern of private insurers as such. The business of such carriers is to assume risks; if a given risk is correctly measured and charged for, it is immaterial whether its magnitude be more or less. Bad risks may evidently be as profitable as good risks, so long as the premium is equally adequate. So narrow a view of the insurance function, however, would be extremely short-sighted. To begin with, it is more difficult to gauge abnormal hazards than to determine the mean hazard of the class: the basis rate rests upon a relatively broad exposure, whereas the superimposed charges are necessarily derived from a much narrower experience. Under competitive conditions, accordingly, rates for sub-standard risks are very apt to be inadequate. Apart from this consideration, insurers have a direct pecuniary interest in reducing loss cost because rate changes commonly lag behind experience changes, so that a progressively improving experience redounds to the advantage of insurance carriers. Most important of all, accident prevention is one of the services which employers have learned to expect from insurers and so has become a factor in competitive selection, particularly as between participating and non-participating carriers. Preventive efficacy, therefore, is a valid criterion of merit rating, even from the standpoint of private competitive insurance.

Approached from the public standpoint, the overwhelming importance of prevention would appear to demand that it be made the primary end of individual risk rating. A state or mutual monopoly could very properly adopt this principle, fixing rigorous standards and imposing charges with an eye single to the elimination of avoidable hazards. Under competitive conditions, however, such a course is scarcely feasible, just because the cost of preventive measures bears no determinable relation to the cost of the accidents

thereby prevented. If the rating system were one of credits only, premium income might well be reduced more than pure premiums, whereas a system of charges only might produce an unpredictable excess of premiums over loss cost. The latter result, indeed, might be thought impossible since, *ex hypothesi,* the charges would suffice to correct the conditions charged for, whereupon the penalties themselves would disappear. Insofar, however, as the expense of making the prescribed improvements should exceed the consequent saving in accident cost, the insurers would be assuming the police functions of the state—a rôle not likely to be welcomed by competitive carriers. Besides, the cost of given improvements is by no means a fixed quantity. It is not simply a compound of so much labor and materials, but is affected as well by general plant conditions, methods of work, labor policies, nature of output and urgency of orders. In practice, therefore, even quite severe penalties for remediable conditions would often result in premium increases which could not well be allowed for in basis rates because of their wholly irregular occurrence. Competitive insurers, accordingly, will prefer to make the adjustment of premiums to hazards the principal, and accident prevention the secondary, aim of merit rating.

The discussion thus far has suggested two fundamental criteria of merit rating; a third is given by the requirements of classification rate making. Compensation insurance rates can never safely be built up by mere synthesis of plant, or even of industry, hazards separately determined; the circumstances which affect both the frequency and severity rates of work accidents are so numerous, so dissimilar, so incontinently changing, and, individually considered, so little susceptible of exact measurement, that accident cost (pure premium) experience of the risk class must always be the main element in any tenable system of accident insurance rates. Precisely on this account, merit rating should not be permitted to obscure basis rates. It is, of course, not essential that charges and credits shall exactly balance—neither excess nor deficit is a serious matter if only the amount thereof can be determined in advance; but it is highly important that the premium results of merit rating shall be predictable, both as a whole and by individual classifications.

It follows from these general considerations that any tenable scheme of individual risk rating must: (1) fairly reflect differ-

ences of hazard as between individual establishments in the same manual classification; (2) stimulate accident prevention; and (3) be so constructed that it will at all times be under statistical control. These criteria now fail to be applied to the two accepted forms of merit grading, commonly known, respectively, as "schedule" and "experience" rating. No extended criticism of existing systems is intended, still less is there any expectation of proposing a detailed solution of admitted difficulties. It is hoped, however, that a restatement of these difficulties in the light of generally accepted principles may suggest at least the direction in which a solution is to be looked for.

I.

Schedule Rating.

All of the well-known rating schedules* at present in use are of the same general type; indeed, all derive, in great part, from the same original. From the standpoint of accident prevention these schedules possess three highly meritorious features: they point out specific defects of plant, equipment and shop management which present remediable hazards, they furnish carefully formulated standards of safeguarding and of safety practice for the employer's guidance in removing these defects, and they set a definite money value, in the way of insurance premium, upon each improvement which the employer is asked to make. Prevention is quite as much a matter of education as of incentive and the educational value of the schedule rating standards is unquestionably large. Perhaps not so much can be said of the item values; the charges and credits in many cases are too small to induce compliance with the requirements. So much is this the case that comparatively few employers trouble themselves to ask for reinspection during the policy period. Nevertheless, comparison of first with subsequent inspections of the same risks indicates a substantial degree of improvement in the respects called for by the schedules. How far these betterments will affect accident cost remains to be seen, though there is no room to doubt that their ultimate influence will be very considerable. To have achieved so much at the very threshold of schedule rating is highly creditable to the framers of these schedules.

* The schedules below discussed relate exclusively to manufacturing industries; they comprise the Massachusetts schedule, the Pennsylvania schedule and the Industrial Compensation Rating Schedule (formerly the Universal Analytic Schedule).

As measures of hazard variation, however, the existing schedules are much less happy than as guides to preventive expedients. An inherently impossible attempt has been made to fit all industries into the same procrustean mold; with few exceptions, the same hazards are enumerated and the same values fixed for bakeries and boiler shops, foundries and saw mills, clothing factories and blast furnaces. It was, of course, not overlooked that accident causes vary extremely, in relative importance, from industry to industry, yet such variations are very inadequately allowed for in any of the existing schedules. Most of the item values are measured by equipment units: so much for each defective flight of stairs, each running foot of unfenced shafting, each exposed train of gears and each unguarded machine. Obviously, however, a flight of stairs has not the same importance in a flour mill with one or two employees on each floor as in an overall factory where it is in daily use by two hundred women and girls. The average exposure to a drive belt or a train of gears is not the same in a brick yard as in a boot and shoe factory. Still less can the same insurance value be predicated (as in the Pennsylvania schedule) of a jordan engine and a rod rolling machine. The Industrial Compensation Rating Schedule attempts, indeed, to meet this difficulty by fixing specific values for the point of operation of enumerated machines* and by grading the credit for general guarding of all machines in accordance with the base rate of the industry affected. But these solutions beget about as many incongruities as they avoid. By the first-mentioned device, a dangerous machine, when guarded, receives more credit than a fully automatic machine which needs no guarding; by the second, the value of the same machine is made to vary from one industry to another while machines of very different hazard are valued at the same rate when found in the same industry. It will scarcely be maintained that a buzz planer is twice as hazardous in a carpentry shop as in a furniture factory, or that a bull dozer becomes of equal importance with a vertical drill by being placed in a machine shop. Neither will it be contended that the addition of a number of drop hammers and power shears, fully guarded at the point of operation, reduces the total hazard of an automobile factory. If the per unit values thus fail to allow sufficiently for differences between industries, still less are such variations reflected by the percentage items. Power transmission,

* A device borrowed from the Massachusetts schedule.

e. g., is greatly more important as an accident cause in planing mills than in iron foundries, yet the latest evolved rating schedule gives equal weight to individual motor drives in the one case as in the other. The same criticism obviously holds of the percentage limitations upon working machine credits—it is too high for blast furnaces and altogether too low for wood working establishments. Even safety organization and first aid provisions can scarcely be said to possess the same value, relatively to total hazard, in clothing factories and steel mills.

None of the existing schedules, in short, reflects plant hazard with even approximate accuracy. Per unit charges and credits tend to be excessive for industries wherein the mechanical equipment bulks large in proportion to payroll exposed,* as also for low-rated industries and low-rate states.† Payroll charges and credits similarly tend to excess when applied to low base rates, not to mention that some of these items amount to flat discounts for the normal conditions of certain industries.‡ When it is added that the item values, whether per equipment unit or proportionate to payroll or to premium, in no case reflect statistically determined hazard quantities, the erratic results of schedule rating are a foregone conclusion. Transmission charges, alone, in particular establishments, have been known to exceed the manual premium calculated to cover the total average hazard of the industry. Conversely, the working machine credits alone of the Industrial Compensation Rating Schedule may approximate the total premium§—a contingency

* This would be true, e. g., of flour milling, stone crushing, and textile manufacturing.

Incidentally, it may be remarked that the per unit charges discriminate unfairly against the small risks, for the payroll exposure per unit of equipment is apt to be less in small than in large establishments.

† The specific charges of the Industrial Compensation Rating Schedule, e. g., would be nearly twice as great, in proportion to manual premium, in Pennsylvania, as in New York. Yet the projectors of that schedule appear to have thought that a limited test upon New York risks alone would sufficiently indicate the premium results in all states.

‡ One story buildings, e. g., are the rule for foundries, steel mills, and stone yards.

§ The annual premium on a silk mill, at Pennsylvania rates, would probably not exceed 65 cents per employee. The credit for general guarding of machines—to say nothing of point of operation—might easily come to 35 cents. The maximum credit of 10 per cent. of premium could be obtained by guarding one-fourth of the machines.

met by the stop limit which gives the same credit for a partly guarded plant as for one that complies with the schedule standards in all respects. Hence practical application of the schedules produces rewards and penalties for industrial establishments that are disproportionate to actual hazard variations, and, at the same time, yields irregular increases and decreases of premium income from the several manual classifications, which increases and decreases are unrelated to any ascertained variation of loss experience.

These shortcomings would be the less serious if schedule rating were subjected to definite statistical control. No one expects finished results from first experiments. But it surely is not too much to expect that each experiment shall be fully utilized for further progress, and this implies that its results shall be quantitatively determined, both in gross and in detail. We need to know, on the one hand, for schedule rated industries as a whole and for each important industry group, both the gross premium effect of schedule rating and the weight of each scheduled item in producing this effect; on the other hand, we need to check the loss experience on schedule rated risks against the charges and credits developed by the schedule. Unhappily, such an analysis of existing schedules is not merely wanting, but is even well-nigh impossible. So far as the writer is aware, no attempt has anywhere been made to check loss experience against schedule rating results, nor have any plans been formulated looking to that end—which is to say that insurance carriers have not sought to ascertain whether they are receiving, or are likely to receive, a *quid pro quo* for their immense outlays upon inspection and rating service.* Of the Universal Analytic Schedule we know only the gross premium results, subdivided by large industry groups and by size of risk. Of the Pennsylvania schedule, alone, do we know the premium charges and credits by industries and by items. Even these returns, in both cases, are based upon estimated, not audited, payrolls. Yet this meager, and sometimes misleading, information is all we are likely ever to obtain of any extant schedule. The causes of this untoward situation lie quite as much in the defective structure of the schedules themselves as in any want of statistical enterprise.

* Inspection service is, of course, partly competitive in purpose and its cost may properly be charged, in part, to expenses of acquisition. So far as inspection is effective for this end the carriers do receive a *quid pro quo*, irrespective of loss results. The statement in the text refers only to the ostensible purposes of accident prevention and equitable rating.

To take only the best known example, the structure of the Industrial Compensation Rating Schedule is such as nearly to defy statistical analysis. The several item values are computed upon no less than three distinct bases: cents per $100 of payroll, per cent. of base rate, and flat amounts per unit of plant equipment. To be sure, these various magnitudes, though dissimilar, are not actually incommensurate; all may be reduced to a common denominator of either rate or premium. Such conversion, however, is more than a statistical complication in the way of determining the effective weight of specific items; it rests, besides, upon an estimated payroll which is always more or less wide of the mark. Indeed, the actual method of converting flat charges and credits into premium rates offers a direct inducement to misrepresentation of payroll, because a very substantial saving may often be effected by a shrewdly calculated under- or over-estimate*—a fact of which insurance brokers are not slow to take advantage. The stop limits present a difficulty of another order, making it impossible, for example, to prognosticate the effect of a given change in working machine credits.† The obstacles to a realistic test of the item values are still more formidable than any yet mentioned, for the items themselves, in their present form, do not fit into any recognized or practicable classification of accident causes. It would, of course, be feasible to ascertain the total premium results of the schedule upon audited policies and to check these results against loss experience upon the same risks. Such an analysis, however, could only show whether the schedule has adversely affected premium income as over against loss cost; it would not avail for the correction of untoward developments, because it would not

* An overestimate will be advantageous to the assured wherever there are many flat charges and few flat credits. Thus upon a true payroll of $100,000 with a $1 rate, flat charges of $150 and percentage or payroll credits of 12 cents would give a net rate *increase* of 3 per cent. If the payroll in this case were estimated at $150,000, the result would be a net *credit* of 3 per cent. At the same time an overestimate of the number of employees will increase the credit, or reduce the charge, for the number of working machines. On the contrary an underestimate of payroll is indicated where there are few flat charges and many machine credits.

† This obstacle might be overcome by a count of guarded machines in excess of the credit limit. But since the point of operation credits are not uniform even within a given industry, it would be necessary to keep a statistical account of each listed type of machines, which would mean a staggering number of cards for a single sizable risk.

reveal either the premium effects or the corresponding hazard values of the several items which go to make up the schedule.

The foregoing criticisms are offered in no carping spirit, nor with any intent to disparage the very substantial merits of the schedules so criticized. On the contrary, it is believed that the deficiencies pointed out can be corrected without abandoning the ground already gained. These deficiencies, it will have been observed, relate, not so much to the items covered, as to the item values and to the organic structure of the schedules. If the above analysis is at all correct, it will be needful: (1) to construct several schedules, each appropriate to a single group of related industries; (2) to derive the item values for each industry group from statistical experience; (3) to relate these values to the total hazard of the industry affected in such a way that schedule rate variations shall correspond, quantitatively as well as qualitatively, to hazard differences, and (4) to devise a structural plan such that the results of schedule rating shall be readily amenable to statistical analysis and control. The details of such a program are obviously far beyond the competence of a mere statistician, yet it may be possible to suggest a method of procedure for carrying it into effect.

The first of the suggested steps should not prove extremely difficult. Underwriters have long recognized that certain industries are closely related to each other in kind and degree of hazard—a relationship dependent upon analogy of industrial processes. What is needed is a systematization of the present somewhat rough-and-ready groupings by an engineering and statistical investigation of component hazards. It is believed that such an inquiry would eventuate in a moderate number of groups, each sufficiently homogeneous to be covered by a single rating schedule.

The determination of item values is a much larger undertaking. Mr. Mowbray has proposed the method of sectional pure premiums. Whether he has in mind an average pure premium, derived by simple addition of the losses and exposures of all states, or a basic pure premium computed by the method of law differentials, is not altogether clear. Values obtained by the former method would evidently be excessive for low rate, and deficient for high rate, states, whereas the law differential method, when applied to each of a considerable number of accident causes and modified by what may be termed partial differentials for different classes of injuries —a step even more necessary for sectional than for total pure

premiums*—would prove extremely laborious. It would, moreover, yield as many sets of item values as there are law differentials—a circumstance which would greatly complicate the application of schedule rating. Still less does it appear feasible to determine the accident cost per unit of equipment. Such an undertaking might present no insuperable obstacles as respects elevators and traveling cranes, but, when carried out for the immense number and variety of features which a rating schedule must take into account, it would involve, beside all the difficulties of sectional pure premium computation, an additional source of error in the shape of inadequate exposures. Mr. Mowbray, indeed, proposes nothing of the sort. If I have rightly understood his plan he would fix a rate on the entire plant payroll for each sectional hazard, as buildings, elevators, transmission, working machinery, etc., and would arrive at the establishment rate by summation of these sectional rates. Assuming that such a plan is workable—upon which question the present writer is not prepared to express an opinion—it would be necessary to grade the sectional hazards in respect of quantity as well as quality. If it be granted for the moment that the elevator pure premium is the same for shoe factories as for department stores, how take account of variations in the number of elevators per $100,000 of establishment payroll? Doubtless, such variations could be expressed in the sectional rate-grade, though only, it would seem, at the cost of much complexity.

On the whole, it would appear simpler, and at the same time sufficiently accurate for the purpose in hand, to build up a rating schedule on the basis of item values expressed as fractions of the group pure premium. This would involve merely the determination of the number and severity of accidents ascribable to each cause, and the assignment of a severity weight to each accident in accordance with some standard scale. The statistical committee of the International Association of Industrial Accident Boards and Commissions has already proposed such a plan whereby the severity of temporary disabilities is to be expressed in terms of actual time loss, that of deaths and permanent total disabilities in

* The total law differential between New York and Wisconsin, e. g., may be taken at 150, but the differential for medical aid is barely 100, for temporary disability benefits about 70, and for death benefits more than 200. Hence the true law differential for electrical injuries, in the cost whereof death benefits greatly preponderate, would be very much different from that for hand tool accidents, the cost of which mainly consists in medical and temporary disability benefits.

terms of working life expectancy, and that of permanent partial disabilities in fractions of permanent total disability, as given, say, by the Imbert Scale. Details of this plan have still to be perfected, but the task should easily be within the resources of members of this Society. Absolute accuracy could not, of course, be claimed for such a method of valuation. Yet if the same method were applied to the industry group and to each component hazard, the relative values should be approximately accurate, and it is only relative values which need to be established for the present purpose.

Purely by way of illustration, the writer has computed, upon the basis of Ohio and Wisconsin experience, the cause-group values for the manufacturing and, separately, for the wood-working industries of those states. It is, of course, recognized that the experience here used is insufficient and, further, that the statistics themselves have not been fully analyzed from the present point of view, so that the values had to be derived, in part, by the method of imputation. Nevertheless, the results for each state agree rather closely with the combined results, so that the whole may be taken as sufficiently accurate for illustrative purposes. The cause groups are those formulated by the statistical committee of the International Association of Industrial Accident Boards and Commissions, with certain minor rearrangements. For schedule making these groups could, of course, be subdivided or recombined to such extent as might be deemed expedient. It will at once appear from the subjoined table that barely one-half of the total hazard in these industries is attributable to mechanical causes, even when that category is extended to comprise boilers and other steam-pressure apparatus, electrical installation, and railway equipment. On the other hand, a fair proportion of non-mechanical accidents arise out of remediable conditions of plant and equipment. Thus analysis of the Wisconsin data included in the table indicates that 5 per cent. of the weighted time loss from falls of persons in the manufacturing industries of that state are due to falls upon stairways, 25 per cent. to falls from balconies, runways, platforms and trestles, 18 per cent. to falls into vats, bins and tanks, and 10 per cent. to stumbling over obstacles in passageways and falls upon uneven, defective or slippery floors. When all such allowances are made, however, there will still remain a large number of accidents which cannot be definitely related to specific items in a rating schedule, though they may be taken account of in arriving at the value of safety organization and education.

RELATIVE IMPORTANCE OF ACCIDENT CAUSES IN INDUSTRIES SUBJECT TO SCHEDULE RATING AS MEASURED BY THE NUMBER AND SEVERITY OF ACCIDENTS ASCRIBED TO EACH CAUSE.*

No.	Causes.	All Manufacturing.†	Wood Working.‡	No.
1	All causes	100.0	100.0	1
2	All machinery	47.1	51.	2
3	Prime movers	1.5	1.0	3
4	Transmission apparatus	7.8	9.0	4
5	Working machinery	24.5	37.5	5
6	Elevators	6.6	2.5	6
7	Cranes and conveyors	6.8	1.0	7
8	Boilers and steam pressure apparatus‖	.8	.5	8
9	Vehicles, power and animal¶	3.3	1.5	13
10	Electricity	1.6	1.0	9
11	Explosives	.6	0.0	10
12	Conflagrations	.3	0.	11
13	Hot, corrosive and poisonous materials	6.4	.5	12
14	Falls of persons	12.1	12.5	14
15	Stepping on or bumping against objects	2.5	3.5	15
16	Falling objects	6.6	8.	16
17	Hand tools	5.4	4.5	17
18	Objects being handled**	12.7	15.0	18
19	Other causes	.8	2.0	19

* Based upon work accidents in Wisconsin, July 1, 1912, to Dec. 31, 1914, and in Ohio, Jan. 1, 1914, to June 30, 1915. The statistics were taken from the official reports of the industrial commissions of those states, supplemented by some special analyses for which the writer is indebted to Messrs. F. C. Croxton and W. H. Burhop.

The weighting system employed is explained in the *Bulletin* of the Industrial Commission of Wisconsin issued August 1, 1915, and entitled "Industrial Accidents."

The percentages given represent total accident weight (number of accidents by severity weight of each).

† Based upon 44,386 compensatable accidents—i. e., accidents which caused death, permanent disability, or temporary disability for more than one week.

‡ Based upon 5,092 compensatable accidents as above defined.

‖ Includes explosions of and escape of steam and hot water from, but excludes other boiler-room accidents.

¶ Includes falls of persons from, while in motion. Probably includes also some accidents improperly charged to manufacturing classifications.

§ Excludes objects dropped in carrying, lifting, loading or unloading.

** Includes hand truck accidents, and all accidents in carrying, lifting, rolling, loading, unloading, or other handling of objects, all without the use of mechanical or animal power.

Structurally, the scheme herein suggested would follow the coal-mine rating schedule of the Associated Companies. Substandard features of the given establishment would be graded in deficiency points whose relative weights would be fixed by the cause-group values already explained. The schedule rate of the establishment would then be determined by the formula:

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

where R is the establishment rate, B the basis rate, U the maximum allowable discount (in per cent. of base rate), X the number of deficiency points developed by the establishment in question, and L the normal number of such points for the industry group. The items in respect to which risks would be graded might be much the same as in the existing schedules, save that their values would be expressed in points convertible into percentages of base rate. The device of the normal allowable points of deficiency, or the number of deficiency points equivalent to base rate, is introduced to secure a balance of premium increases and decreases upon schedule rated risks. Normals for each industry group would, of course, be determined statistically, by analysis of actual inspection reports. Such determination, however, would be comparatively a simple matter; it is even probable that existing inspections would afford sufficient data for the purpose.

The practical operation of such a schedule may conveniently be illustrated from the treatment of the machine hazard in wood-working establishments. The tentative table of values already recited indicates that working machines comprise 37.5 per cent. of total hazard in this group of industries, or 37.5 charge points in a total of 100. The working machine charges of a particular risk would then bear such ratio to 37.5 points as the number of unguarded machines per 100 employees bears to the normal proportion of working machines in the classification to which the risk belongs. Algebraically the computation may be expressed:

$$N = 37.5\frac{\frac{WM}{100}}{\frac{LWM}{100}} = 37.5\frac{WM}{LWM},$$

where N is the number of machine charges (in points), $WM/100$

the actual number of working machines per 100 employees, and *LWM*/100 the normal proportion for the classification. In computing the ratio, *WM*/100, a completely guarded machine should count for only a fraction (say one-half) of the full machine hazard. Similarly, separate allowance might be made for guarding at the point of operation, as distinguished from general guarding. It might even be feasible to assign different weights to different types of machines, so that a square-head jointer, e. g., would count for more than a turning lathe. These, however, are matters of engineering detail. The distinguishing feature of the proposed method of treatment is that all phases of working machine hazard—type of machines, quality of guarding and amount of equipment per unit of exposed payroll—sum up in a single ratio to total hazard of the industry. Sash, door and blind establishments, e. g., grade all the way, in character of operations and of output, from planing mills to furniture factories. Under the proposed plan, mill "A," with the full classification number of working machines (92 per 100 employees) would receive the full charge of 37.5 points if all machines were unguarded ($N = {}^{92}/_{92}$ 37.5), and one-half charge, or 18.75 points, if all machines were completely guarded ($N = {}^{46}/_{92}$ 37.5). Under the like conditions mill "B," which has only 69 machines per 100 employees, would carry, respectively, 28⅛ and 14$^{1}/_{16}$ points [$N = {}^{69}/_{92}$ 37.5 and $N = {}^{69}/_{92}$ 37.5]. That is to say, the machine charge ratio between the two plants is the same when both are completely guarded as when both are wholly unguarded: the premium rate expresses the quantitative relationship in mechanical hazard. The like result, obviously, cannot be predicated of any existing schedule.

It is believed that the method above sketched for the rating of working machines could be applied as well to transmission apparatus; perhaps also to traveling cranes, elevators, and certain other hazard features. Other hazards, apparently, could only be measured by the unit method; such, for instance, are defective floors, unrailed stairways and unprotected balconies. Some features, lastly, and those not the least consequential, would probably be subsumed under the somewhat vague captions of safety organization and safety measures, whereof no statistical valuation appears to be possible. In short, neither the plan herein outlined, nor any other yet proposed, would altogether do away with judgment values. The hazard of a guarded as compared with an unguarded

punch press, of individual motor drive as compared with shaft transmission, or of a variety shaper as compared with a belt sander or a buzz saw, the accident prevention value of toe boards per 100 feet of overhead balcony, or the accident insurance cost of a hole in the floor, can never be mathematically determined. The suggested plan, however, would limit the function of personal judgment, except in the realm of so-called "moral" hazards, to fixing the relative weights of individual items within a group whose total weight is statistically determined.

It has already been intimated that the method of rating by specific hazard values will not hold for such features as safety organization and education, first aid provisions, character and permanence of the working personnel, methods of work, shop discipline, and whatever else may be comprised within the undefined limits of "moral hazard." It cannot be safely assumed, as was done in formulating the coal-mine schedule, that these features of plant management affect only that residue of accident causes for which definable conditions of plant and equipment fail to account. On the contrary, these intangible elements affect for good or ill every source of accidental injury. For that very reason, their value, though unquestionably large, is indeterminate: they cannot be isolated in a given establishment, nor can their results be satisfactorily compared from establishment to establishment on the "other-things-equal" assumption—other things are never equal in the requisite degree. Moral, or, to borrow Mr. Mowbray's expressive term, morale, hazards, do not lend themselves to objective determination by a rating inspector; they must be graded, if at all, by more or less arbitrary indicia whose validity rests upon personal judgment. When it is added that the total weight of the moral hazard group, no less than the relative weight of each specific indicium, is almost wholly a matter of personal judgment, it will appear that these hazards can scarcely be fitted into a rating schedule based upon analysis of accident causes. On the whole, it would appear preferable to measure establishment morale by means of experience rating, and to take account in schedule rating only of conditions which can be ascertained by inspection and the approximate values of which can be derived from accident statistics.

To recapitulate: It is proposed to construct several industry-group schedules, each limited to such tangible hazards as can fairly be graded by inspection, to derive the premium values of these hazards

from accident statistics, and to apply the values thus determined to the grading of individual risks by means of score points which shall bear a simple ratio to classification basis rates. These proposals, though they may be new in their present application, are by no means novel in themselves. In essentials, the scheme above outlined is taken bodily from the coal mine rating schedule of the Associated Companies. What is here attempted is to show that a schedule of the same type can be adapted to manufacturing industries and that this type of schedule, more nearly than any of the existing systems, would fulfill the fundamental requirements of schedule rating: namely, effectiveness for accident prevention, equitable rate adjustment and facility of statistical control.

1. As a stimulus to accident prevention the suggested scheme should prove not less effective than the best existing schedules. Not only would it possess the same features of definite standards, specific enumeration of defects, and direct pecuniary incentive; it would set a more adequate value upon the major hazards, and it would allow full credit only for full compliance with the prescribed requirements.

2. Since the item values of the suggested schedule would be proportionate to hazard weights in the particular industry group, and since the establishment rate produced by the application of these item values would express the actual degree of compliance or noncompliance with prescribed safety standards, the resultant premium increases and decreases should bear a tolerably close and uniform relation to establishment hazard. That the proposed plan would afford an exact measure of hazard differences between establishments, even as respects the hazards taken into account, cannot, of course, be pretended. It should, however, give a far closer approximation to such a result than can ever be attained by a rating system built upon judgment values.

3. Lastly, the structure suggested is such as to facilitate intelligent control. Inasmuch as all item values would be equivalent to percentages of basis rates, the premium effect of each item could readily be determined. The values themselves could be revised whenever necessary from later statistical experience and the premium results of such revision could be predicted with reasonable accuracy. The same remark would hold equally of the normal deficiency points for each industry group. These normals, indeed, would afford the readiest means of maintaining a balance of premium increases and decreases, for any excess or deficit could ob-

viously be wiped out by changing the value of either U or L in the formula $R = B(1 - U) + UB(X/L)$. This high degree of flexibility is not least among the merits of the proposed hazard grading schedule. No system of prospective rating, not even the basis rates themselves, will ever achieve a perfect balance of projected with realized losses. To say nothing of inadequate exposures and of errors of judgment or of computation, accident rates are ever fluctuating from causes which cannot be foreseen. Whence the necessity that every element of rate making, whether for risk classes or for individual risks, shall be kept under continued statistical observation and control.

This paper has already so far overpassed reasonable grounds that any consideration of experience rating must be deferred to a later occasion.

NOTE ON AN APPLICATION OF BAYES' RULE IN THE CLASSIFICATION OF HAZARDS IN EXPERIENCE RATING.

BY

ARNE FISHER.

In a recent review in the *Journal* of the Royal Statistical Society of my treatise on "The Mathematical Theory of Probabilities" under the discussion of the sixth chapter, dealing with Bayes' Theorem, the reviewer states:

"Upon the whole we agree with Mr. Fisher's conclusions respecting the theorem, but we should need much space to define our exact measure of agreement. We may, however, remark that the real value of Bayes' principle seems to reside in its application to the study of consistency, that is to say to the problem of determining whether two or more samples can properly be regarded as having been derived from one and the same 'universe.' This aspect of the matter has not engaged Mr. Fisher's attention."

This suggestion of a further—although not new—application of the famous and often misused Rule of Bayes is of some value in classifying hazards inside various industries in workmen's compensation, and I gladly take the opportunity to extend my discussion of the principle as originally developed in my book, especially in view of the fact that this renowned theorem has received very little attention among actuaries, mostly due to a completely false conception of the true Rule of Bayes as given in the usual discussions under what is known by the ambiguous name of "inverse probability."

Starting from first principles we have observed a certain event, E, the probability of which is unknown, to have happened m and failed $s - m$ times in s total trials (samples). Using the principle of equal distribution of ignorance as the basis of our calculations, merely assuming that all possible events are, in the absence of any grounds for inference, equally likely, the probability that the event, E, will occur in a following trial (i. e., in the $s + 1$ trial) is expressed by the integral:

$$P = \left[\int_0^1 y^{m+1}(1-y)^{s-m}dy\right] \div \left[\int_0^1 y^m(1-y)^{s-m}dy\right].$$

(See Fisher, "Probabilities," pages 72–74.)

The probability that the event, E, will occur n times and fail $t-n$ times in a second series of t total trials (order of happening of the individual events being immaterial) may then be expressed as follows:

$$P_{(t,n)} = \frac{\lfloor t}{\lfloor n \lfloor t-n} \frac{\int_0^1 y^{m+n}(1-y)^{s-m+t-n}dy}{\int_0^1 y^m(1-y)^{s-m}dy}.$$

Letting n assume all integral values from $n=0$ to $n=t$, we get the various probabilities that E will happen 0, 1, 2, 3 . . . or t times in the second series of t trials. The sum of all those probabilities must necessarily equal unity as some one of those combinations is bound to occur. Hence we have:

$$\sum_{n=0}^{n=t} P_{(t,n)} = 1.$$

The values of $P_{(t,n)}$ for various integral values of n are easily computed from the table of Degen. (See Fisher, "Probabilities," page 101.)

The great practical value of the formula lies in its application to test whether two samples may be regarded as belonging to the same type or universe. A few illustrations will better serve to illustrate this statement.

Example 1.—The Danish physician and biologist, Dr. Permin, in his "Tetanusstudier" gives the following observations on treatment of tetanus (lockjaw) by means of serum. One hundred ninety-nine cases of tetanus were not treated with the serum and only 42 or 21 per cent. were cured. Another sample of 189 cases were treated with the serum and 80 or 42 per cent. were cured. The question is now: Is the variation due to sampling, or would it be reasonable to assume that the serum has been favorable?

Here $s=199$, $m=42$, $t=189$, $n=80$.

Substituting these values in the formula we have, using Degen's Table:

log |122 =	202.9945390	log |389 =	840.2439992
log |266 =	531.1078500	log | 42 =	51.1476782
log |200 =	374.8968886	log |157 =	278.0692820
log |189 =	349.7071362	log | 80 =	118.8547277
	1458.7064138	log |109 =	176.1595250
			1464.4752121

or $\log P_{(189, 80)} = \bar{6} \cdot 2312192$, $P_{(189, 80)} = \cdot 000001703$.

Hence the probability that the two samples are identical is about 2 in a million, or we may say with certainty that the serum has been beneficial.

Example 2.—A certain tannery with a payroll of 1,008,000 has shown a loss during the year of 8,000. Another tannery with a payroll of only 251,000 has in the same year shown a loss of 3,000. Would it be reasonable to assume that the second plant was inferior to the first in safety protection? I have no doubt that many of our so-called "practical" safety experts would jump to the conclusion that on the strength of those figures the second plant had shown a safety standard of 50 per cent. less than the first plant, the loss ratio being 12 per 1,000 as against 8 per 1,000 of the first plant. Now let us see how the same problems look in the light of the theory of probabilities. Choosing 10,000 as the unit of payroll and 1,000 as the unit of losses, we have here a neat little problem in chance, worded as follows. A first sample of 100 observations showed 8 successes, what is the probability that a second sample of 25 observations will give 3 successes?

The formula gives

$$(s = 100,\ m = 8,\ t = 25,\ n = 3).$$

log | 11 =	7.6011557	log |126 =	211.3751464
log |114 =	186.4054419	log | 8 =	4.6055205
log |101 =	159.9743250	log | 92 =	142.0947650
log | 25 =	25.1906457	log | 3 =	0.7781513
	379.1715683	log | 22 =	21.0507666
			379.9043498

Hence $\log P_{(25, 3)} = \bar{1} \cdot 2672185$, or $P_{(25, 3)} = \cdot 185020$.

In other words, we may expect that the loss will be 12 per 1,000 in about 19 in 100 cases, by no means a rare occurrence. "Safety

experts" please take notice and don't make rash conclusions, as it is quite probable that the apparent increase in hazard simply is due to random sampling.

I give below a complete tabulation of the probabilities of $P_{(25,n)}$ for various values of n from 0 and upwards.

When $s = 100$ and $m = 8$

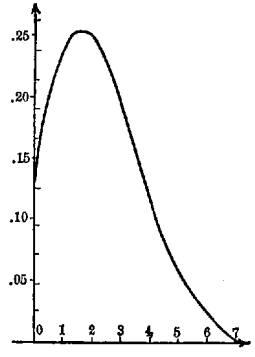
n	$P_{(25,n)}$
0	.126823
1	.243890
2	.252300
3	.185020
4	.107117
5	.051757
6	.021565
7	.007910
8	.002589
9	.000763
10	.000203
11	.000049
12	.000011
13	.000002
14–25	.000000

The above table shows that we can expect a loss of 3,000 or more in a sample of 250,000 in about 39 out of 100 cases, such excessive loss being due entirely to random sampling (chance) and not due to other influences.

Fitting the above data to a Charlier B curve (Poisson-Charlier Frequency Curve) we obtain, as will be seen from the accompanying figure, a decidedly skew distribution, indicating once more how careful we must be in using a normal Gaussian distribution in compensation work.

I could go on and quote number upon number of fallacies of medical health officers and actuaries who with truly procrustean efforts attempt to verify a pet theory of their own by samples too small to be representative. It is, I am sure, only the mathematically trained statistician who will be able to tell whether deviations from standard rates are the result of random sampling or due to truly representative causes. When preferential rate-making just now is

in such vogue in American assurance circles, I can but apply a friendly warning to the statisticians and actuaries to be extremely careful and, before making a final decision, to submit the data to a painstaking mathematical analysis, which again should be undertaken only by the properly trained expert.



Mr. Mowbray, as well as Mr. Woodward, have mentioned the importance of chance variation in compensation rate making. Unfortunately only a few members of this Society seem to recognize the important bearing this has upon the whole subject of rate making, as well as the fact that such variation due to random sampling can be treated by mathematical methods only. Although the above application of some of the most elementary theorems in the theory of probabilities constitutes only a modest attempt to show what can be accomplished by such methods, I have the impression that my deductions will from many sides be viewed as having no "practical" bearing on compensation rates. Personally, I feel that this little word "practical" has been greatly abused by many statisticians and the gibe—alas only too common—that mathematical statistics is of theoretical interest only, is not justified. The engineer and the chemist use mathematics in nearly every branch of their work. Yet, nobody accuses them of being impractical, not even when the telephone engineer employs the higher criterions of probabilities in estimating the future revenues of a specified group of subscribers. Modern electrical and chemical engineering rest on essential mathematical foundations. Where would electrical engineering be to-day without the aid of the mathematical researches of a Fourier, a Helmholtz, a Hertz, a Maxwell or a Kelvin? Lord Kelvin once said that "there is no part of mathematics the

engineer might not apply." I for one believe that this holds true to a still greater extent for statistics. Many a time I have had occasion to feel the limitations of my elementary mathematical training in certain statistical problems where a thorough knowledge of the higher methods of modern mathematical analysis would have carried me over the difficulties.

The day may not be so very far off when the practical statistician will be required to have a thorough mathematical training. By this I do not mean that the statistician must be a pure mathematician. Statistics must be handled *with* mathematics, not *as* mathematics. Herein lies often the danger of the pure mathematicians who often lose sight of the fact that mathematics is only a tool—although a very powerful one—in statistical analysis. This danger has been shown in the conventional and absolutely erroneous method of presenting and applying Bayes' Rule in most of those American universities I have had occasion to visit. Only through a mutual understanding between the statisticians and the mathematicians such errors in application of method to practical problems may be avoided. It is up to the statisticians to take a more conciliatory view towards the introduction of mathematical methods in statistics instead of taking a suspicious, if not actually acrimonious and ignoring attitude towards the lonely little band of students who attempt to reach a mutual understanding with the mathematicians. Such an understanding does not exist and seemingly there is a wide, and so far unbridged, gap between the mathematicians and the statisticians. What we actually need is an "entente cordiale."

Temporary and Permanent Disability Reserves.

BY

MILES M. DAWSON.

The movement to increase the percentage of earned premiums charged as the claim reserve under workmen's compensation policies from 55 per cent. to 60 per cent. immediately and to 65 per cent. two years from December, 1916, at latest indicates, perhaps, anew the utter unsuitability of this method and the improbability, amounting indeed to impossibility that it will assure solvency, even though these reserves are held.

It may be well, in consequence, to consider in what manner this troublesome question may otherwise be dealt with and especially in what manner it has been successfully dealt with, elsewhere.

Our debt to the State Insurance Fund (Rijksverzekeringsbank) of Holland is already great, since it has supplied us the data by means of which to compute the value of annuities terminable upon remarriage. It again lays us under obligation, however, by supplying a basis for setting up reserves prior to the determination of how the disabled workmen will emerge, i. e., restored, permanently totally disabled, permanently partially disabled or dying in consequence of the accident. Before hitting upon this method the managers of the Fund made, as they put it, "several attempts at a general and direct solution of the problem, all of which proved unsuccessful"; in consequence of which the following course has been adopted.

As regards payments under disabilities less than one month old, the aggregate to be paid for the first month is usually known before the valuation is in fact made and the number who will have been disabled more than one month is known, together with the number of months elapsed and the amount per diem of the disability benefits. These for purposes of the valuation are listed as follows:

These are the present values, according to the experience of the State Insurance Fund, taking into account all the financial contingencies, e. g., recovery, partial or total permanent disability, or death as a result of the accident.

Months Since Accident.	Number Still Entitled.	Aggregate per Diem.	Reserve per $1.00 per Diem.	Total Reserve.
1–2	....	....	464.00	....
2–3	....	....	957.00	....
3–4	....	....	1,322.00	....
4–5	....	....	1,624,00	....
5–6	....	....	1,876.00	....
6–7	....	....	2,093.00	....
7–8	....	....	2,286.00	....
8–9	....	....	2,451.00	....
9–10	....	....	2,589.00	....
10–11	....	....	2,708.00	....
11–12	....	....	2,814.00	....
12–13	....	....	2,906.00	....
13–14	....	....	2,988.00	....
14–15	....	....	3,063.00	....
15–16	....	....	3,134.00	....
16–17	....	....	3,199.00	....
17–18	....	....	3,261.00	....
18–19	....	....	3,317.00	....
19–20	....	....	3,367.00	....
20–21	....	....	3,410.00	....
21–22	....	....	3,445.00	....
22–23	....	....	3,472.00	....
23–24	....	....	3,502.00	....
24–25	....	....	3,529.00	....
25–26	....	....	3,559.00	....
26–27	....	....	3,590.00	....
27–28	....	....	3,621.00	....
28–29	....	....	3,641.00	....
29–30	....	....	3,655.00	....
30–31	....	....	3,663.00	....
31–32	....	....	3,666.00	....
32–33	....	....	3,671.00	....
33–34	....	....	3,678.00	....
34–35	....	....	3,688.00	....
35–36	....	....	3,705.00	....
36–37	....	....	3,724.00	....
37–38	....	....	3,747.00	....

The law of Holland provides for benefits to dependents nearly the same as under the New York Law and also for the payment of total disability benefits during total disability but not for the fixed term payments for certain forms of partial disability. On the whole, however, these figures might serve for New York business, in case the experience as to recovery, emergence into partial or into total permanent disability or death would be the same or very nearly the same here as in Holland. It should not widely differ.

From the cases so valued in Holland, however, all cases which have meanwhile been determined by the medical officers to be permanently disabled, either totally or partially, are eliminated and separately valued by means of annuities. The rule is so to classify

VALUES OF u_{x+s}, s.

X.	μ_x, 0.	μ_{x+1}, 1.	μ_{x+2}, 2.	μ_{x+3}, 3.	μ_{x+4}, 4.	μ_{x+5}, 5.	μ_{x+6}, 6.	μ_{x+7}, 7.	μ_{x+8}, 8.	μ_{x+9}, 9.	μ_{x+10}, 10.	μ_{x+11}, 11.
10	.9826	.9657	.9456	.9714	.9791	.9822	.9840	.9858	.9883	.9906	.9927	.9947
11	.9822	.9650	.9446	.9706	.9784	.9816	.9836	.9855	.9880	.9904	.9926	.9947
12	.9819	.9642	.9437	.9698	.9777	.9810	.9832	.9853	.9878	.9901	.9925	.9946
13	.9816	.9634	.9428	.9690	.9770	.9805	.9829	.9852	.9876	.9900	.9923	.9946
14	.9812	.9626	.9420	.9682	.9764	.9801	.9826	.9850	.9874	.9898	.9923	.9945
15	.9808	.9620	.9412	.9675	.9758	.9796	.9823	.9848	.9873	.9897	.9921	.9944
16	.9806	.9614	.9404	.9668	.9753	.9792	.9820	.9847	.9871	.9895	.9921	.9944
17	.9803	.9608	.9396	.9661	.9747	.9787	.9818	.9845	.9870	.9894	.9919	.9943
18	.9800	.9602	.9390	.9655	.9742	.9783	.9815	.9844	.9869	.9893	.9918	.9942
19	.9797	.9597	.9383	.9648	.9737	.9780	.9812	.9842	.9867	.9891	.9917	.9942
20	.9795	.9592	.9377	.9643	.9732	.9777	.9810	.9841	.9866	.9891	.9916	.9941
21	.9793	.9588	.9371	.9638	.9728	.9775	.9808	.9840	.9865	.9890	.9915	.9940
22	.9791	.9584	.9366	.9633	.9723	.9772	.9806	.9838	.9864	.9889	.9914	.9938
23	.9789	.9580	.9360	.9629	.9719	.9769	.9805	.9837	.9862	.9888	.9912	.9937
24	.9787	.9576	.9355	.9624	.9715	.9767	.9803	.9835	.9860	.9887	.9910	.9936
25	.9785	.9573	.9351	.9620	.9712	.9766	.9802	.9834	.9858	.9885	.9911	.9934
26	.9783	.9571	.9348	.9616	.9710	.9765	.9801	.9833	.9856	.9885	.9910	.9933
27	.9782	.9568	.9345	.9612	.9706	.9764	.9800	.9831	.9856	.9884	.9908	.9931
28	.9780	.9566	.9342	.9609	.9704	.9763	.9798	.9830	.9856	.9882	.9907	.9929
29	.9779	.9564	.9340	.9605	.9703	.9763	.9799	.9830	.9854	.9881	.9905	.9927
30	.9777	.9562	.9338	.9602	.9702	.9764	.9798	.9828	.9853	.9879	.9904	.9925
31	.9776	.9560	.9335	.9598	.9702	.9763	.9797	.9827	.9852	.9878	.9902	.9922
32	.9775	.9559	.9333	.9597	.9701	.9764	.9796	.9826	.9851	.9877	.9900	.9919
33	.9773	.9557	.9333	.9594	.9702	.9764	.9795	.9825	.9851	.9875	.9897	.9916
34	.9772	.9556	.9331	.9592	.9702	.9764	.9795	.9823	.9849	.9874	.9895	.9913
35	.9771	.9555	.9330	.9590	.9701	.9765	.9794	.9822	.9847	.9872	.9894	.9909
36	.9769	.9553	.9329	.9588	.9702	.9764	.9793	.9820	.9845	.9871	.9890	.9905
37	.9768	.9552	.9328	.9586	.9703	.9764	.9792	.9818	.9844	.9869	.9887	.9900
38	.9766	.9551	.9327	.9587	.9705	.9763	.9791	.9817	.9842	.9866	.9884	.9895
39	.9765	.9549	.9327	.9587	.9706	.9763	.9791	.9816	.9840	.9863	.9879	.9890
40	.9763	.9548	.9327	.9590	.9707	.9764	.9790	.9814	.9838	.9859	.9874	.9884
41	.9761	.9457	.9327	.9594	.9709	.9764	.9789	.9811	.9835	.9855	.9869	.9877
42	.9759	.9546	.9329	.9600	.9711	.9763	.9787	.9809	.9320	.9851	.9864	.9870
43	.9757	.9547	.9334	.9606	.9713	.9762	.9785	.9805	.9827	.9845	.9858	.9862
44	.9756	.9548	.9339	.9613	.9714	.9762	.9782	.9802	.9822	.9839	.9850	.9854
45	.9754	.9550	.9344	.9620	.9716	.9759	.9779	.9799	.9817	.9832	.9842	.9844
46	.9753	.9552	.9351	.9628	.9716	.9758	.9777	.9795	.9811	.9824	.9833	.9834
47	.9751	.9555	.9359	.9636	.9717	.9755	.9773	.9790	.9805	.9816	.9824	.9823
48	.9750	.9558	.9368	.9640	.9717	.9752	.9769	.9785	.9797	.9807	.9812	.9810
49	.9749	.9561	.9377	.9647	.9716	.9748	.9765	.9778	.9789	.9796	.9801	.9797
50	.9747	.9565	.9386	.9653	.9716	.9744	.9759	.9771	.9780	.9786	.9787	.9782
51	.9745	.9568	.9396	.9655	.9715	.9739	.9753	.9764	.9770	.9772	.9772	.9765
52	.9743	.9572	.9406	.9657	.9711	.9733	.9746	.9755	.9758	.9759	.9757	.9747
53	.9741	.9575	.9416	.9659	.9707	.9727	.9738	.9743	.9746	.9744	.9739	.9728
54	.9738	.9578	.9424	.9659	.9702	.9702	.9719	.9727	.9732	.9728	.9720	.9706

VALUES OF u_{x+s}, s.

x.	μ_x, 0.	μ_{x+1}, 1.	μ_{x+2}, 2.	μ_{x+3}, 3.	μ_{x+4}, 4.	μ_{x+5}, 5.	μ_{x+6}, 6.	μ_{x+7}, 7.	μ_{x+8}, 8.	μ_{x+9}, 9.	μ_{x+10}, 10.	μ_{x+11}, 11.
55	.9734	.9580	.9433	.9658	.9697	.9708	.9716	.9719	.9717	.9710	.9699	.9682
56	.9729	.9581	.9440	.9656	.9688	.9699	.9704	.9705	.9699	.9689	.9676	.9657
57	.9724	.9582	.9448	.9651	.9679	.9687	.9690	.9689	.9680	.9668	.9651	.9628
58	.9718	.9582	.9454	.9645	.9668	.9673	.9675	.9669	.9658	.9644	.9624	.9597
59	.9711	.9581	.9461	.9637	.9657	.9658	.9655	.9648	.9635	.9617	.9593	.9564
60	.9703	.9580	.9465	.9627	.9643	.9640	.9636	.9625	.9609	.9588	.9559	.9527
61	.9694	.9576	.9468	.9616	.9627	.9622	.9614	.9600	.9580	.9554	.9523	.9486
62	.9683	.9571	.9470	.9601	.9608	.9600	.9589	.9572	.9548	.9519	.9483	.9442
63	.9671	.9565	.9468	.9585	.9587	.9577	.9562	.9540	.9513	.9480	.9440	.9394
64	.9657	.9556	.9464	.9567	.9565	.9551	.9532	.9507	.9476	.9437	.9493	.9341
65	.9641	.9545	.9458	.9546	.9540	.9522	.9500	.9470	.9433	.9390	.9340	.9284
66	.9623	.9531	.9448	.9523	.9511	.9490	.9465	.9429	.9387	.9339	.9284	.9221
67	.9602	.9515	.9435	.9495	.9479	.9455	.9425	.9384	.9337	.9283	.9221	.9153
68	.9579	.9495	.9418	.9465	.9445	.9415	.9380	.9333	.9280	.9220	.9153	.9078
69	.9553	.9472	.9399	.9432	.9406	.9372	.9329	.9277	.9219	.9153	.9078	.8997
70	.9524	.9446	.9376	.9395	.9364	.9323	.9275	.9216	.9151	.9078	.8997	.8909
71	.9492	.9417	.9349	.9354	.9318	.9270	.9214	.9150	.9078	.8997	.8909	.8813
72	.9456	.9383	.9316	.9309	.9266	.9212	.9149	.9078	.8997	.8909	.8813	.8710
73	.9417	.9345	.9280	.9259	.9208	.9147	.9077	.8997	.8909	.8813	.8710	.8597
74	.9373	.9302	.9238	.9204	.9146	.9076	.8997	.8909	.8813	.8710	.8597	.8475
75	.9324	.9255	.9190	.9143	.9076	.8997	.8909	.8813	.8710	.8597	.8475	.8343
76	.9271	.9201	.9134	.9074	.8997	.8909	.8813	.8710	.8597	.8475	.8343	.8201
77	.9212	.9141	.9070	.8997	.8909	.8813	.8710	.8597	.8475	.8343	.8201	.8042
78	.9147	.9073	.8997	.8909	.8813	.8710	.8597	.8475	.8343	.8201	.8042	.7865
79	.9076	.8997	.8909	.8813	.8710	.8597	.8475	.8343	.8201	.8042	.7865	.7675
80	.8997	.8909	.8813	.8710	.8597	.8475	.8343	.8201	.8042	.7865	.7675	.746
81	.8909	.8813	.8710	.8597	.8475	.8343	.8201	.8042	.7865	.7675	.746	.723
82	.8813	.8710	.8597	.8475	.8343	.8201	.8042	.7865	.7675	.746	.723	.697
83	.8710	.8597	.8475	.8343	.8201	.8042	.7865	.7675	.746	.723	.697	.671
84	.8597	.8475	.8343	.8201	.8042	.7865	.7675	.746	.723	.697	.671	.642
85	.8745	.8343	.8201	.8042	.7865	.7675	.746	.723	.697	.671	.642	.610
86	.8343	.8201	.8042	.7865	.7675	.746	.723	.697	.671	.642	.610	.576
87	.8201	.8042	.7865	.7675	.746	.723	.697	.671	.642	.610	.576	.53
88	.8042	.7865	.7675	.746	.723	.697	.671	.642	.610	.576	.53	.40
89	.7865	.7675	.746	.723	.697	.671	.642	.610	.576	.53	.40	.00
90	.7675	.746	.723	.697	.671	.642	.610	.576	.53	.40	.00	
91	.746	.723	.697	.671	.642	.610	.576	.53	.40	.00		
92	.723	.697	.671	.642	.610	.576	.53	.40	.00			
93	.697	.671	.642	.610	.576	.53	.40	.00				
94	.671	.642	.610	.576	.53	.40	.00					
95	.642	.610	.576	.53	.40	.00						
96	.610	.576	.53	.40	.00							
97	.576	.53	.40	.00								
98	.53	.40	.00									
99	.40	.00										
100	.00											

the case if "the medical officer declares that a change (increase or decrease) in the degree of incapacity is impossible within the lapse of a year."

All such cases are valued by an annuity table, so computed as to represent "the average rate of diminution of an annuity, first, by mortality among permanently disabled workmen, second by reactivity (i. e., recovery), third by decrease or increase of degree of incapacity." These factors have been provided for 11 years succeeding the injury and are, in practice, supplemented beyond that period by mortality factors only. Tables of values of annuities corresponding with these can readily be prepared, merging into the Danish Survivorship or any other suitable table after the lapse of the eleven years.

The preceding table presents the factors which the State Insurance Fund of Holland uses for the computation of the value of total and permanent disabilities, taking into account all of the elements of risk. They are used in a manner similar to the probabilities of survival in computing ordinary annuity values.

When $S > 11$ the value of $u_{x+s,\ s}$ may be found by means of the formula:

$$u_{x+s,\ s} = u_{(x+s-11)+11,\ 11}.$$

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

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

VOL. II, PAGE 347.

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

VOL. II, PAGE 356.

WRITTEN DISCUSSION.

MR. E. H. DOWNEY:

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

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

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

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

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

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

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

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

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

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

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

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

MR. C. W. FELLOWS:

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

Experience Rating.

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

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

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

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

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

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

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

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

A Possible Alternative for Experience Rating.

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

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

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

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

Feasibility of a Deductible Average Plan.

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

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

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

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

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

Retroactive Experience Rating of All Large Risks.

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

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

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

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

MR. LEON S. SENIOR:

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

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

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

Analysis of the New York Experience Rating Plan.

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

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

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

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

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

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

2. How shall medical cost be valued?

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

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

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

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

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

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

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

(1) Resulting in fatal,

(2) Permanent disability,

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

(4) All other compensatable accidents.

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

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

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

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

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

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

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

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

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

MR. G. F. MICHELBACHER:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ORAL DISCUSSION.

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

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

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

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

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

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

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

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

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

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

MR. WINFIELD W. GREENE:

(AUTHOR'S REVIEW OF DISCUSSIONS.)

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

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

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

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

1. All prospective risks have to be classified.

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

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

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

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

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

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

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

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

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

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

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

MR. JOSEPH H. WOODWARD:

(AUTHOR'S REVIEW OF DISCUSSIONS.)

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

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

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

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

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

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

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

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

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

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

VOL. II, PAGE 370.

WRITTEN DISCUSSION.

MR. JAMES D. CRAIG:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

and may take the form:

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

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

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

which is a somewhat simpler form.

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

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

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

When pensions are promised under legislative action or other-

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

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

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

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

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

MR. HENRY MOIR:

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

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

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

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

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

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

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

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

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

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

MR. GEORGE B. BUCK:

(AUTHOR'S REVIEW OF DISCUSSIONS.)

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

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

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

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

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

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

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

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

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

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

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

VOL. II, PAGE 387.

WRITTEN DISCUSSION.

MR. G. F. MICHELBACHER:

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

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

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

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

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

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

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

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

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

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

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

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

The charges for the worst possible mine will be

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

where

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

and

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

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

Now, let X represent the Coefficient of Hazard.

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

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

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

and

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

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

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

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

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

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

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

$$Y = aX + b,$$

where

$Y =$ final adjusted rate

and

$X =$ coefficient of hazard.

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

It is obvious

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

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

Let us assume that

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

Then, in accordance with the two propositions advanced above,

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

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

From these two equations

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

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

and

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

or

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

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

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

MR. WILLIAM NEWELL:

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

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

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

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

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

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

TABLE II.

RATE DISTRIBUTION OF ANTHRACITE MINES.

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

TABLE III.

RATE DISTRIBUTION OF BITUMINOUS MINES.

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

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

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

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

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

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

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

VOL. II, PAGE 394.

WRITTEN DISCUSSION.

MR. ALBERT H. MOWBRAY:

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

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

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

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

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

Mr. Fisher points out that in determining pure premiums by

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

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

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

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

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

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

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

MR. ARNE FISHER:

(AUTHOR'S REVIEW OF DISCUSSION.)

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

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

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

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

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

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

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

VOL. II, PAGE 418.

ORAL DISCUSSION.

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

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

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

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

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

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

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

Editor's Note.

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

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

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

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

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

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

VOL. II, PAGE 427.

WRITTEN DISCUSSION.

MR. WILLIAM LESLIE:

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

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

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

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

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

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

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

MR. JOHN L. TRAIN:

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

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

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

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

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

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

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

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

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

ORAL DISCUSSION.

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

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

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

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

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

MR. RICHARD FONDILLER:

(AUTHOR'S REVIEW OF DISCUSSIONS.)

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

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

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

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

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

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

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

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

CURRENT NOTES.

Westergaard on the Scope and Method of Statistics.

In the September, 1916, number (Vol. XV, No. 115) of the *Quarterly Publications* of the American Statistical Association, Professor Harald Westergaard, dean of Scandinavian statisticians, has an inspiring message for his American co-workers. A careful reading of his article reveals what one may well expect of the Scandinavian School, a blending, a reconciliation of the severely descriptive, encyclopedic statistical methods of the Germans with the, perhaps, over-emphasis of the modern English School upon mathematical analysis of statistical data. The American bystander in this bloodless conflict should welcome any effort for stabilizing the field of the preparation and analysis of statistical data; recent attempts to evolve a systematic course of instruction in the elements of statistics for associateship examinations in this Society brought out clearly the imperative need of some connected discussion of statistical conceptions and practical methods which would adequately cover the field.

Professor Westergaard's article may stimulate such effort on the part of American statisticians. In this connection, it may be well to indicate that a translation of Westergaard's "Theory of Statistics," 1915 Danish text, would go far toward supplying this need until such time as American experience shall warrant a statement growing out of American needs.

Insurance Company Studies Sickness in Typical American Communities.

The Metropolitan Life Insurance Company has issued a preliminary report on the findings of its sickness survey of Boston, Massachusetts, during the two weeks beginning July 16, 1916. Three previous surveys, published as reprints by the United States Public Health Service, are available for distribution. Copies may be secured upon application to the company.

Comparability of Accident Mortality Statistics.

The report of the American Public Health Association committee on the accuracy of certified causes of death, rendered at the

meeting in October 1916, is of considerable interest to students of accident mortality statistics. The accident statistics of populations have been used in the general study of the accident problem, as in Hoffman's "Industrial Accident Statistics," and any important conclusions on the methods of preparing these statistics should be brought to the attention of accident statisticians.

The committee considered each of the titles in the International List of Causes of Death, 1909 Revision, and submitted critical comment upon the titles and the subordinate terms classified under such titles. For causes of death, code numbers 155–186—External Causes, the committee examined the terms usually classified under the titles and recommended a separate tabulation of such deaths as were dependent upon the occupation of decedent. The committee also consulted with a representative of the committee on statistics of the International Association of Accident Boards and Commissions, and sought to have the systems of accident nomenclature and classification established by each committee practically uniform as to inclusions and forms of tabulation. The report of the committee may be had as Public Health Reprint No. 363, Reports of the United States Public Health Service, September 22, 1916.

Medical and Surgical Statistics of the French Army.

Under the direction of Dr. Jacques Bertillon, formerly chief statistician of the city of Paris, the French Ministry of War is compiling the statistics of wounds to French and Allied soldiers in the present European War. Classifications for character of injury, extent of disability, part of body affected, and other items have been prepared and the tabulation of the data is proceeding. It is hoped that valuable information will be obtained on the character and nature of wounds in respect of duration and nature of treatment, the results of surgical operations, etc.

Compensation Statistical Plan and Manual Classifications Code.

For the past several years the National Workmen's Compensation Service Bureau has been developing a comprehensive plan for the compilation of workmen's compensation statistics. This plan is now in use not only in the offices of Bureau companies, but also in the offices of several Non-Bureau companies interested in casualty statistics. It has, furthermore, been discussed by com-

mittees interested in the problem of uniform compensation statistics and has served as a basis for many decisions of such committees. It is believed to be the most complete scheme for the compilation of workmen's compensation experience that has yet been devised. Copies may be secured from the Bureau (13 Park Row, New York) at the rate of 75 cents per copy.

The Manual Classifications Code, which has been specially arranged for the convenience of statisticians, may be obtained for the price of 60 cents per copy.

Insurance Company Publishes Cancer Monograph.

The Prudential Insurance Company has published Frederick L. Hoffman's "The Mortality from Cancer throughout the World." The work was compiled primarily to "facilitate the statistical study of the cancer problem throughout the world." The volume totals over eight hundred pages of text and tables. In the text Mr. Hoffman discusses in turn: the statistical method in medicine, the statistical basis of cancer research and other technical considerations. The first two chapters would serve as a text for an elementary understanding of the aims and purposes of statistics as applied to problems of disease study generally. The cancer experience of the German invalidity funds, the connection between cancer and predisposing injuries to bodily tissue, and other observations on cancer as an occupational disease are of interest to members of the Society. The book is distributed only to reference libraries and to students of the cancer problem.

Richard Brodin is the actuary of the United Life and Accident Insurance Company.

Arthur H. Craig is assistant secretary of the National Automobile Underwriters Conference.

Everett S. Fallow has been appointed assistant actuary in the casualty department of the Travelers Insurance Company.

Fred S. Garrison has been elected assistant secretary of the Travelers Indemnity Company.

James W. Glover prepared the "United States Life Tables, 1910," which has been issued by the Bureau of the Census.

Edward S. Goodwin has resigned as statistician of the Travelers Insurance Company to become associated with the banking house of F. R. Cooley and Co. in the direction of a statistical department.

Carl M. Hansen is the managing director of the Pennsylvania Mutual Liability Association.

L. G. Hodgkins is now secretary and general manager of the National Automobile Underwriters Conference.

Edwin W. Kopf has been appointed assistant statistician of the Metropolitan Life Insurance Company.

G. F. Michelbacher, at present statistician, has been appointed actuary of the National Workmen's Compensation Service Bureau.

James F. Mitchell has resigned as secretary of the Maryland Casualty Co. to become first assistant United States manager of the General Accident Fire and Life Assurance Corporation.

Members are requested to send to the Editor items for publication under Current Notes.

THE CASUALTY ACTUARIAL AND STATISTICAL SOCIETY OF AMERICA.

THE COUNCIL.

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MEMBERSHIP OF THE SOCIETY, OCTOBER 27, 1916.

FELLOWS.

Those marked (†) were Charter Members at date of organization, November 7, 1914.

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, Statistician, American Mutual Liability Ins. Co., 50 State St., Boston, Mass.
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, Massachusetts Employees Ins. Assn., 185 Devonshire St., Boston, Mass.
†	Budlong, W. A., Superintendent of Claims, Commercial Travelers Mutual Accident Assn., Utica, N. Y.
Feb. 19, 1915	Burns, F. Highlands, 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., Actuary and Assistant 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., Treasurer, Massachusetts Employees Ins. Assn., 185 Devonshire St., Boston, Mass.
†	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., Assistant Secretary, National Automobile Underwriters Conference, 80 Maiden Lane, New York.
†	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., Office of Miles M. Dawson, Consulting Actuary, 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, Manufacturers and Trades Casualty Co., 819 Dime Bank Bldg., Detroit, Mich.
May 19, 1915	Deutschberger, Samuel, Chief Examiner, Underwriters' Association Bureau, New York Ins. Dept., 165 Broadway, New York.
Oct. 22, 1915	Dickey, D. R., Statistician, Casualty Co. of America, 68 William St., 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., Actuary, Pittsburgh Life & Trust Co., Pittsburgh, Pa.

†	Egbert, Lester D., Fidelity & Casualty Co., 92 Liberty 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., Assistant Actuary, Equitable Life Ins. 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., Secretary Liability Department, Casualty Company of America, 68 William St., 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, 25 Church St., New York.
Oct. 22, 1915	Graham, George, Actuary, Missouri State Life Ins. Co., St. Louis, Mo.

Oct. 22, 1915	Graham, T. B., 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, 1 Beacon St., Boston, Mass.
†	Greene, Winfield W., Actuary and Insurance Manager, State Industrial Commission, State Capitol, Denver, Col.
†	Hamilton, R. C. L., Comptroller, Hartford Accident & 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, Office of Joseph Froggatt & Co., In-Insurance Accountants, 25 Church St., New York.
†	Hillas, Robert J., President, Fidelity & Casualty Co., 92 Liberty St., New York.
†	Hoage, R. J., Statistician, Industrial Insurance Commission, Olympia, Wash.
Oct. 22, 1915	Hodgkins, L. G., Secretary and General Manager, National Automobile Underwriters Conference, 80 Maiden Lane, New York.
†	Hoffman, Frederick L., Statistician, Prudential Ins. Co., Newark, N. J.
Oct. 22, 1915	Holland, Charles H., 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, B. 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., ~~Assistant~~ Actuary, Connecticut General Life Ins. Co., Hartford, Conn.
Feb. 19, 1915	Landis, Abb, Consulting Actuary, First National Bank 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, State Industrial Commission, 230 Fifth Ave., New York.
†	Luckett, D. G., Secretary, United States Casualty Co., 80 Maiden Lane, New York.
Feb. 19, 1915	Maddrill, James D., Travelers Ins. Co., Hartford, Conn.
†	Magoun, W. N., General Manager, Pennsylvania Compensation Rating & Inspection Bureau, Finance Bldg., Phila., Pa.
†	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.
†	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, Travelers Ins. Co., Hartford, Conn.

†	Morrison, James, Accountant, Royal Indemnity Co., 84 William St., New York.
†	Mowbray, Albert H., Secretary and Actuary, Massachusetts Employees Ins. Assn., 185 Devonshire St., Boston, Mass.
†	Mullaney, Frank R., Fidelity & Casualty Co., 92 Liberty St., New York.
†	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., Secretary and General Manager, Michigan Employers Casualty Co., Lansing, Mich.
†	Otis, Stanley L., 161 W. 140th St., 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 of Insurance, State Capitol, Denver, Col.
Oct. 22, 1915	Rowe, J. Scofield, Vice-President, Aetna Life Ins. Co., Hartford, Conn.
†	Rubinow, I. M., Secretary, Social Insurance Committee, American Medical Assn., 131 E. 23rd St., New York.
†	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., Assistant Secretary, Fidelity & Casualty Co., 92 Liberty 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.

Feb. 19, 1915	Smith, George Lambert, Comptroller, New England Casualty Co., 4 Liberty Square, Boston, Mass.
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, Secretary, London Guarantee and Accident Co., Ltd., London, Eng.
†	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., London, Eng.
†	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.
†	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	
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. 22, 1915 Brann, Ralph M., Assistant Manager, State Compensation Ins. Fund, Denver, Col.

(1) Oct. 22, 1915 Brockway, U. H., Travelers Ins. Co., Hartford, Conn.

Oct. 22, 1915 Buffler, Louis, Jr., State Ins. Fund, 230 Fifth Ave., New York.

Oct. 22, 1915 Feder, Marcy, Assistant Examiner, New York Ins. Dept., 165 Broadway, New York.

Oct. 22, 1915 Levy S. Leon, Ocean Accident & Guarantee Corporation, 59 John St., New York.

Oct. 27, 1916 McClure, Laurence H., Aetna Life Ins. Co., Hartford, Conn.

Oct. 22, 1915 McGuire, Vincent G., State Industrial Commission, 230 Fifth Ave., New York.

Oct. 27, 1916 McManus, R. J., Travelers Ins. Co., Hartford, Conn.

Oct. 27, 1916 Miller, Tilford W., Travelers Ins. Co., Hartford, Conn.

Oct. 22, 1915 Müller, Fritz, New York Life Ins. Co., 346 Broadway, New York.

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.

Oct. 27, 1916 Waite, A. W., Aetna Life Ins. Co., Hartford, Conn.

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 27, 1916.

	Fellows.	Associates.	Total.
Membership, May 26, 1916	139	13	152
By Resignation	1	—	1
	138	13	151
Additions:			
By Election—Oct. 27, 1916	2	—	2
By Examination—Oct. 27, 1916	—	8	8
Membership, October 27, 1916	140	21	161

ABSTRACT FROM THE MINUTES OF THE THIRD ANNUAL MEETING, OCTOBER 27 AND 28, 1916.

The seventh regular meeting of the Casualty Actuarial and Statistical Society of America was held at the Hotel Astor, New York City, on October 27 and 28, 1916.

Vice-President Mowbray called the meeting to order on October 27, 1916, at 10.45 A. M. The roll was called, showing the following forty-eight Fellows and nine Associates present:

FELLOWS.

BLACK	FONDILLER	MILLIGAN
BUDLONG	FORBES	MOIR
CAMMACK	FURZE	MOORE, G. D.
CARPENTER	GOULD	MOWBRAY
CRAIG, A. H.	GRAHAM, T. B.	MULLANEY
CRAIG, J. D.	GRAHAM, W. J.	NICHOLAS
DAWSON, A. B.	HESS	ORR
DAWSON, M. M.	HUGHES	OTIS
DE KAY	HUNT	RYAN
DEARTH	HUNTER	SCATTERGOOD
DEUTSCHBERGER	JACKSON	SCHEITLIN
DOWNEY	KIME	SENIOR
DUNLAP	KING	STRONG, W. M.
FALLOW	LAIRD	WOLFE, L. J.
FISHER	LUBIN	WOLFE, S. H.
FLYNN	MICHELBACHER	WOODWARD

ASSOCIATES.

BROCKWAY	MCGUIRE	MÜLLER
LEVY	MCMANUS	NEWELL
MCCLURE	MILLER	VAN TUYL

Messrs. M. A. Brooks, P. L. Davis, C. H. Forsyth and C. H. Waterbury were present as guests of the Society.

The President's annual address was presented.

The minutes of the meeting held May 26 and 27, 1916, were approved as printed in the *Proceedings*.

The report of the Council was read and, upon motion, adopted by the Society.

The Council recommended the following two men for election to Fellowship in the Society, without examination, under the terms of Article III of the Constitution:

Cogswell, Edmund S., Third Deputy Insurance Commissioner, State House, Boston, Mass.

Hardy, Edward R., Assistant Manager, New York Fire Ins. Exchange, 123 William St., New York.

After ballot, these nominees were declared duly elected Fellows. Vice-President Flynn then took the chair.

The report of the Secretary-Treasurer was read and accepted. A summary follows:

It is interesting to note that during the second year of the Society's existence, in addition to papers on workmen's compensation, other branches of casualty insurance were on the Society's programs. There were papers on accident and health insurance, burglary insurance statistics, the normal probability curve, cost accounting in casualty insurance, pension fund valuation, steam boiler underwriting, and accident frequency.

During the year, and including those to be admitted at this meeting, the membership has increased by eleven Fellows and eight Associates. However, five Fellows have withdrawn, producing a net increase of six Fellows and eight Associates. The total membership is 161 as shown in the following table:

Meeting of	Fellows.	Associates.	Total.
October 22 and 23, 1915	134	13	147
February 25, 1916	5	—	5
May 26 and 27, 1916	4	—	4
October 27 and 28, 1916	2	8	10
	145	21	166
Withdrawals	5	—	5
Membership October 27, 1916	140	21	161

The report of the Editor-Librarian was read and accepted. A summary follows:

During the fiscal year October 1915–October 1916, the second year of the Society's existence, Volume II of the *Proceedings* was issued. This volume consists of Numbers 4, 5 and 6, which are the products of the three meetings held by the Society. One thousand copies each have been printed of Numbers 4 and 5 and twelve hundred copies were printed of Number 6. The growth of the *Proceedings* is shown in the following table:

Number.	Pages.	Papers.	Discussions.	Reviews.
1	76	3	0	3
2	130	5	3	2
3	125	8	2	1
Total, Volume I	331	16	5	6
4	186	13	0	4
5	147	7	4	5
6	188	10	3	3
Total, Volume II	521	30	7	12

The library of the Society has had a number of accessions, due principally to exchanges with actuarial and statistical societies. Various official reports and miscellaneous documents have also been received.

The Committee on Examinations submitted a report, which was accepted. A summary follows:

Examinations were held on May 3 and 4, 1916, throughout the United States. Two Associates presented themselves for examination in Part I of the Fellowship examination, both of whom had passed, as follows:

Brockway, U. H., Travelers Ins. Co., Hartford, Conn.

Van Tuyl, Hiram O., Assistant Examiner, New York Ins. Dept., 165 Broadway, New York.

Nineteen candidates for Associateship presented themselves for examination, of whom the following eight candidates had passed and been enrolled as Associates by direction of the Council:

Baridon, Felix E., Travelers Ins. Co., Hartford, Conn.

Bernstein, Abraham, Accountant, State Insurance Fund, 230 Fifth Ave., New York.

McClure, Laurence H., Aetna Life Ins. Co., Hartford, Conn.

McManus, R. J., Travelers Ins. Co., Hartford, Conn.

Miller, Tilford W., Travelers Ins. Co., Hartford, Conn.

Newell, William, Chief Safety Engineer, State Insurance Fund, 230 Fifth Ave., New York.

Waite, A. W., Aetna Life Ins. Co., Hartford, Conn.

Waite, Harry V., Travelers Ins. Co., Hartford, Conn.

Four candidates took only Part III of the Associateship examination, of whom one passed:

Hoskins, James E., Thayer Hall, Harvard University, Cambridge, Mass.

The following amendments to the Constitution and By-Laws, proposed and approved by the Council and brought before the Society in due and regular form at its meeting on May 26 and 27, 1916, were, on motion, adopted.

Article IV of the Constitution was amended to read as follows:

"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."

The fourth and fifth paragraphs of Article III of the By-Laws were amended to read as follows:

"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."

The annual elections were then held and the officers and members of 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, 1918).....E. H. DOWNEY.
Member of Council (Term to expire October, 1918).....GEORGE D. MOORE.
Member of Council (Term to expire October, 1917).....JOHN M. LAIRD.
Member of Council (Term to expire October, 1917).....S. HERBERT WOLFE.

Recess was taken until 2.30 P. M., during which time luncheon was served at the Hotel Astor.

Upon reconvening, an informal discussion on social insurance was participated in by a number of members.

The papers printed in this number were read or presented.

The Society reconvened on October 28, 1916, at 10 A. M.

The reading and presentation of papers was resumed. The papers read at the last meeting of the Society were then discussed.

Upon motion, the meeting adjourned at 1.00 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 1917.* Examinations will be regularly held in May, 1917, 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 1918, 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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OF

The Casualty Actuarial and Statistical Society of America

APRIL 20, 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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Paul Dowell

PROCEEDINGS

OF

The Casualty Actuarial and Statistical Society of America

1916-1917

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PRESS OF
THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

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VOLUME III, PART II NUMBER 8

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VOLUME III, PART II. NUMBER 8.

PROCEEDINGS

APRIL 20, 1917.

ADDRESS OF THE PRESIDENT, JAMES D. CRAIG.

Last December a Conference on Social Insurance was held in Washington, D. C., under the auspices of the International Association of Industrial Accident Boards and Commissions. While nominally the function of this Association is to consider awards under compensatable accidents, in reality the Conference went far beyond this and considered not only the "merits and demerits of different forms of administration," but all allied subjects in connection with Compensation Insurance, as well as Health, Invalidity and Old Age Insurance, Retirement Allowances, Maternity Benefits, Mothers' Pensions, Unemployment and Savings Bank Insurance.

The men who presented papers included some of the greatest students of the day on these subjects. Naturally, each author emphasized the merits of his plan to a greater extent than the demerits, so that a clear conception of the "pros" and "cons" presented can only be obtained by a close study of the arguments of both sides. As Mr. George B. Chandler, Commissioner, Workmen's Compensation Commission of Connecticut, wrote:

"We usually defend and advocate the method or system with which we are most familiar. It is quite natural that as an administrator of the district system I should appear as its defender."

Before this body it would not be appropriate to enter upon a prolonged discussion of the merits or demerits of the plans presented, but these should be of interest to a group of actuaries and statisticians, and as hints for further development, a few of the major points of interest will be touched upon. These must be presented simply and solely from the scientific aspect, which is the only one of common interest to us.

Considering the subjects in the order presented, the first is the different forms of administration. On this we could satisfy ourselves with the remark of Mr. Chandler that

"Any official of average intelligence and common honesty can do good work under almost any system if he is let alone,"

but one or two administrators of monopolistic funds mentioned certain rules and practices adopted by them, the approval of which this Society would hesitate about giving. Mr. Geo. A. Kingston, Commissioner, Workmen's Compensation Board of Ontario, referring to the separate groupings, known as "Schedule II," for railways, steamship lines, telegraph, telephone and express companies, explains that in event of the accidental death of an employee, the value of the benefit to his widow is the present worth of the pension according to the death and re-marriage table, and then goes on to say:

"Should the pensioner die in the early years of the pension period, the board usually repays the unexpended balance of such deposit to the employer, but should the pensioner live long enough to exhaust the deposit, plus accumulated interest earnings, the board will go back to the employer for the required balance."

Surely, if the probability of death and re-marriage has been taken into consideration in determining the present worth of the benefit, no actuary would approve the payment of the balance of such deposit in event of death of the beneficiary. When it is realized that the return of such balances must result in a deficit, the advisability of making them should be seriously questioned. To those not familiar with the business, the deficit so created will not appear in the early years, but will become embarrassing only after a number of years have elapsed, and the practicability of then going back to the employer for an additional assessment may well be questioned. Surely such an employer would have a right to expect that the payment made by him years ago was in full settlement of all claims.

We are also interested in the statement by the same author that

"all our reserves are calculated upon a 5 per cent. interest earning basis."

Such a rate would probably not be permitted in this country, nor would it be considered very conservative by the members of this Society. When the possibility and, in fact, probability of going back to employers for any required balance is considered, would it not be the part of conservatism to use a lower rate of interest and

apply the excess earnings where needed, rather than to adopt this high rate, which carries no margin at all? To show that this rate of interest is high it is simply necessary to state that according to the "Insurance Year Book," published by The Spectator Company, the average rate of interest for the years 1896 to 1915 earned by twenty-nine life insurance companies was but 4.77 per cent.

Another point to which your attention should be called is the statement of Mr. Kingston that

"Our expense ratio in Ontario was about 5 per cent. for 1915—that is, 5 per cent. of our gross assessment,"

and on this matter Mr. T. J. Duffy, Commissioner, Industrial Commission of Ohio, remarked that the expenses of the Ohio State Fund amounted to 6 per cent. of the premiums. While we have no complaint to offer about a low expense ratio, it behooves us to take cognizance of these ratios, in order to determine whether the management which can produce such a low figure is really effective or whether the supervision of the claims alone should not require at least such a percentage.

Passing from the subject of administration to that of carriers, two thoughts appear prominent and both are very striking. In the first place we have unanimity in the desires of the managers of state funds and those of private insurance companies for fair play and open competition, while in the second place we have the sad experience of many carriers. As regards open competition, Mr. F. Spencer Baldwin, Manager of the New York State Fund, after stating the arguments for different funds, pleaded strongly for a fair test of the competitive state funds, objecting only to

"the use of competitive methods that do not square with the standards of fair play,"

and maintaining:

"It is apparent that a state fund cannot perform its function properly, or even demonstrate conclusively its success or its failure, unless it is permitted to compete actively with the insurance companies,"

while Mr. Edson S. Lott, President of the United States Casualty Company, speaking for the companies, states:

"The stock companies are willing that as many public and private self-supporting methods of insurance as the people want shall compete with them. They ask no favors. But they do ask that they be permitted to remain competitors. Let the fittest survive."

With the general desire for free competition, the members of this Society must be in hearty accord, as whatever our personal opinions may be, we can only get a broad experience through the manifold activities of various organizations and particularly as this is needed at the present time when the sad experience of many carriers is related. At present the record is too uncertain and discouraging to warrant any other opinion than that the different carriers must continue in active competition until the problem of permanency is solved, and it can hardly be claimed that the problem has been solved at the present time, when state funds are being declared insolvent and private companies are being liquidated. Such a remarkable display of failures was pictured that it will be well to list them for your benefit. As regards the failure of the state funds, Mr. Lott writes:

"Where is the experience upon which the would-be monopolist of state insurance bases his prophecy of reduced cost when the state takes sole charge?

"Not in Norway, where the government has a monopoly of compensation insurance and put its rates so low at the outset that a heavy deficit resulted.

"Not in New Zealand, where the state fire insurance office did the same thing, and then was forced to adopt the rates charged by the competing commercial companies.

"Not in Italy, where, when commercial life insurance was abolished a few years ago, the governmental monopoly fixed its rates at approximately the figures which the companies had charged.

"Not in Wisconsin, where the state fire insurance fund and the state life insurance fund are fizzles.

"Not in New York, where the state fund reversed itself between May and September of this year, offering in May that those who insured with it would receive 'substantial dividends,' and deciding in September that no dividends would be paid for that period.

"Not in North Dakota, where the state hail insurance fund is a fiasco.

"Not in Ohio, if the Chairman of the Kentucky Workmen's Compensation Board is right in his pending controversy with the Actuary of the Ohio State Fund,"

while as regards private companies, Mr. Baldwin tells us:

"Thirteen of the stock companies lost money on their 1915 compensation business in this State, and the 1916 experience will doubtless be even worse. The pressure of these conditions has accelerated the natural tendency toward concentration of compensation business through the reduction of the number of companies writing this insurance. Already three mutuals and six stock

companies, which started writing compensation insurance in New York State in 1914, have withdrawn from the field."

The function of this Society is to place compensation insurance upon a firm basis. Apparently we have not done this either with state funds or with private companies, and the failure of either one reflects upon us. Are we not yet educated to the fact that when a state fund goes bankrupt a body blow is dealt to compensation insurance and when a stock company goes into the hands of a receiver the confidence of the community is shaken? Our business is to understand the fundamental principles of insurance and then to insist that, irrespective of who carries it, the business shall be upon a solid foundation. Individual cases of mismanagement will always occur, but when so many state funds and so many private companies find themselves in difficulty within such a short time, it behooves the actuary or statistician to give heed. With such a record before us, instead of placing the New York State Fund in the class of non-successes as does Mr. Lott, should we not approve its course in passing its dividend as one tending toward that greater goal, conservatism and permanency? Would not the business be better off if less emphasis were placed on experience rating or schedule rating with their tendency to lower rates? It is hardly necessary for me to here dwell on a subject which is so familiar to the members of this Society, but is not a great part of the financial difficulties experienced due to the reduction of premiums on account of over-refined rating systems?

One of the basic principles of insurance is that rates are predicated upon averages and not on individual risks, and are not most of our troubles due to the violation of this basic principle? It is the making of a sufficient rate, based upon a large class, and its adoption for individual risks that has made life insurance financially sound, but the same tendency of getting away from an average rate to an individual rate is now being gradually adopted in group life insurance, much to the concern of life insurance actuaries. Instead of the business of casualty insurance adopting the proven system of life insurance, it looks as though it is, temporarily at least, forcing some of its troublesome principles upon the life insurance branch of the business. Would it not be better for this Society to first advise the casualty business to get its own house in order before attempting too great refinements in the way of schedule and experience rating?

Passing now to the subject of health insurance, we find the same arguments being advanced for compulsory health insurance under state funds as were advanced in advocacy of workmen's compensation. The first of these is the lessening of the cost by substituting compulsion for persuasion, while the second is through universal membership to include those who probably now need insurance the most, but do not carry it. In like manner, the same arguments are advanced for private health insurance, namely, individual freedom and success in competition through service and initiative. It is only natural that Insurance Superintendent Potts, of Illinois, in commenting on joint stock health insurance, should say:

"So far as I can see, it has but one important advantage, which is that it excels other kinds of health insurance in financial soundness,"

or

"The existence of competition from private companies would have a tendency to secure efficient service and capable management of the state institution and compel its operation at the lowest possible cost."

Neither were we surprised to hear him say, in a criticism of the fact that health companies have returned but 44 per cent. of the premiums in benefits, that

"Without imputing any personal shortcomings in this respect to those engaged in the business of corporate health insurance, I cannot refrain from characterizing a system which consumes more than half of the premiums paid, in expenses and profits, as not only entirely indefensible from the economic standpoint, but as grievously wrong morally and demanding immediate reformation."

One important difference between compensation insurance and health insurance, however, lies in the fact that prior to compensation insurance, the only recognized protection for employees was through the liability insurance offered by private insurers, whereas health insurance, even before compulsory insurance was agitated, was being granted not only by stock and mutual companies, but by trade unions, benefit associations and by employers.

According to Mr. Potts, nearly $16,750,000 had been paid as health insurance benefits in the five years from 1911 to 1915 by stock companies. Mr. G. W. Perkins, President of the Cigar Makers' International Union of America, stated that down to January 1, 1916, that Union had paid over $4,000,000 for sick

benefit purposes. Mr. Geo. A. Ranney showed that in the operation of the Employees Benefit Association of the International Harvester Company nearly 450,000 days of sickness had been incurred by its members, while the Pennsylvania Railroad, through Mr. E. B. Hunt, showed that from February 15, 1886, to September 30, 1916, nearly $33,000,000 had been disbursed for disablements and deaths and over $1,000,000 paid as superannuation allowances to retired members. Naturally, each insurer pointed to the benefits paid from its fund and concurred with Mr. Perkins, who stated, in regard to the trade unions:

"I venture the opinion that society at large owes the unions, which pay these benefits, a debt which can only be wiped out by subsidizing the unions, through regular financial contributions computed upon a fair basis, for its outlay in this direction. It cannot be successfully denied that we are caring for the sick and the unemployed and burying the dead, and that in so doing we are in a measure lifting just that much of the burden from the shoulders of society at large."

In addition to these major organizations there are numerous smaller ones. Mr. Edgar Sydenstricker, Public Health Statistician, U. S. Public Health Service, stated that

"A survey of existing agencies for health insurance in the United States must necessarily be incomplete at this time,"

but quoting from a report on health insurance in New York City, stated:

"'There exist in this great cosmopolitan city literally thousands of petty health insurance funds,'"

and then:

"We are not yet in a position to appreciate fully and accurately their value and their weaknesses from the standpoints of coordinating them into a comprehensive system of health insurance, such as exists in Germany and Great Britain, and of correlating them with our probable health agencies and the great movement for disease prevention."

We are not seriously concerned with the existence of the various funds, their management or correlation, but with the effect if present conditions are changed and compulsory health insurance inaugurated. The members of this Society should have a clear conception of past experience, in order that they may consider the prob-

able future experience. Unfortunately, most of the papers presented on this subject were not printed in galley form and we must look elsewhere for the arguments presented. To the hopes and desires of the advocates of the various plans of social insurance, we can take no exception. We would not criticize those people who have the welfare of the working men and women at heart and would not quarrel with their motives, but, as scientific men, we must substitute facts for impressions and predicate our future upon the past. It is a common experience that reform administrations do not last long for the simple reason that the campaign promises are impossible of fulfillment. The expectations created cannot be fulfilled and disappointment leads to overthrow. So with the new developments of social insurance—if they are coming, do not let us be too optimistic in our expectations. Let us be careful to appreciate the facts and not issue misleading statements.

Dr. Irving Fisher, of Yale University, in the "*American Labor Legislation Review*" for March, 1917 (Vol. VII, Publication 36), states at page 17:

"According to Dr. Zacher, reputed to be the best authority on health insurance in the world, twelve years were added to the worker's life span during thirty years of health insurance. We may properly attribute part, if not most of this increase to health insurance."

Compare this statement with the facts available in the Statistical Year Book of the German Empire for the year 1915. On page 39 appear tables of expectations of life for ten-year periods on male lives and assuming the worker's life to begin at age 15, we have the following figures for that age:

TABLE SHOWING THE EXPECTATION OF LIFE IN THE GERMAN EMPIRE ON MALE LIVES FROM THE MORTALITY TABLES OF DIFFERENT TEN-YEAR PERIODS.

Period.	Expectation of Life at Age 15—Male
1871–72–1880/81	42.38 years
1881–1890	43.54 "
1891–1900	45.31 "
1901–1910	46.71 "

According to this table, the expectation of life at age 15 has increased 4.33 years, which is apparently a long way from twelve years, but is this 4.33 increase attributable to health insurance? English Life Table No. 4, covering the years 1871–1880, shows an

expectation of life at age 15 on males of 43.41 years, while Life Table No. 7, covering the years 1901–1910, shows an expectation of life on males of 47.31 years, so that the increase without health insurance is 3.90 years. Based on these returns, instead of saying that the worker's life span had been increased twelve years, part of which, if not most, being due to health insurance, would it not be nearer the truth to say that during these thirty years, the worker's life has been increased 4.33 years, of which nearly six months may be attributable to the effect of health insurance? While no standard tables in America have been published, some data are available from the records of a large industrial life insurance company to show that the increase in the expectation of life in this country compares favorably with that abroad. The expectation of life according to tables prepared by this company from its experience on white males during 1914 showed an increase of 4.66 years over that shown by a similar table prepared from its experience during 1894.

Dr. Fisher also says:

"At present we find the United States, in striking contrast to health insured Europe, is suffering from an increase of the death rate after middle life."

The alleged increase in the death rate after middle life in the United States is not discernible in the experience of industrial companies. In one large company there has been an improvement in mortality at the older ages, although it has not been as marked as at the younger ages. Possibly such apparent increases as have been observed are due to special causes. Dr. Louis I. Dublin, in a paper entitled "The Increasing Mortality after Age Forty-Five—Some Causes and Explanations," read before the American Statistical Association in March, 1917 (*Quarterly Publications,* Vol. XV, No. 117), pointed out that immigration was an important factor in American mortality which had not been sufficiently studied in connection with changes in the mortality rate. He concluded his paper as follows:

"There is no evidence at hand at the present time to justify the statement that conditions of life in America are increasing the mortality rates at the productive ages."

It is interesting to observe the closeness between the mortality rates of males in Germany and England both thirty years ago and at the present time. The rates in the United States cannot be com-

pared for thirty years ago, as they are not available, but those given by Mr. James W. Glover in his *United States Life Tables, 1910,* compare favorably with the more recent tables of both Germany and England. The figures follow, but allowance should be made for the low rate at age 70 in the English Life Table No. 4, as this is probably due to the method of graduation.

TABLE SHOWING MORTALITY RATE AMONG MALES DURING THE YEARS 1871–1881.

Age.	German Empire 1871–1881.	English Life Table No. 4.
40	.01363	.01389
50	.02145	.02039
60	.03820	.03545
70	.08108	.06988

TABLE SHOWING MORTALITY RATE AMONG MALES DURING THE YEARS 1901–1910.

Age.	German Empire, 1901–1910.	English Life Table, No. 7.	United States Life Tables, Original Registration States, 1910.
40...	.00922	.00931	.01046
50...	.01693	.01657	.01581
60...	.03260	.03262	.03104
70...	.06936	.06707	.06240

While the mortality of 1910 under the Original Registration States covers only the death claims in 1909, 1910 and 1911, it is significant that it is below both that of the German and the English experience for the years 1901 to 1910.

Let us not deceive ourselves. The general improvement in mortality as shown by the available statistics is keeping pace with that abroad and while health insurance may have been a factor in the general scientific study of disease prevention, it has not been the all-important one. Whether or not compulsory health insurance comes, we must look forward with a clear knowledge of results experienced in the past. There may continue to be an improvement in mortality, accompanied, as it has been in Germany, by an increase of 50 per cent. in the sickness rate and a corresponding increase in England. On the other hand, the rates of both mortality and sickness may move in cycles and as a result of the present war we may experience a radical change in both rates. It is easily within the realm of possibilities that the death rates throughout the world

will show substantial increases within the next decade with either increases or decreases in the sickness rates. Let us frankly state that whatever health insurance will cost this year, it may carry another cost next year and, by so doing, convince the world at large that we are cognizant of the difficulties of the problem. Above all, let us give full weight to the difficulties, rather than underestimate them. Let us be conservative in our statements, rather than extravagant, and if losses should not come up to our estimates, the remedy is easy to apply by an extension of benefits. Do not let us advocate a system under which in a year or two, state funds or approved societies or fraternals or independent companies or other carriers will be in financial difficulties. Let us remember that probably no greater catastrophe could happen to a state health fund than to be compelled to follow a state compensation fund to the legislature for an additional grant in order to make good the deficiencies caused by building too high and making too extravagant promises.

PROVISION FOR EXPENSES IN WORKMEN'S COMPENSATION PREMIUMS.

BY

JOSEPH H. WOODWARD.

Such proportion of an insurance premium as is or may be assumed to be applicable to or necessary for the payment of all costs of conducting the business over and above the value of the benefits provided in the policy contract is commonly known as the *loading*. It includes such allowance for taxes as may be necessary and such specific provision for stockholders' profit or dividends to policyholders as may be decided upon.

In branches of insurance other than life insurance there has been but little discussion of the theory upon which premiums should be loaded to provide for expenses.* It has generally been assumed—at least in practice—that to the pure premium (being such portion of the office premium as is necessary to pay losses) there should be added a percentage of itself to provide for the expenses of acquisition, administration, adjustment, etc. The simple hypothesis underlying this assumption appears to be that expenses should, in general, be assessed in proportion to the value of the insurance benefits provided. More careful analysis, however, seems to show that such an hypothesis is too general to furnish a complete solution; that, while true in a general way, greater refinements of method must nevertheless be introduced if material inequities in premium rates are to be avoided.

The expenses of providing workmen's compensation insurance may conveniently be analyzed into four general groups, as follows:

1. Expenses proportional to the office premium (mainly acquisition expense and taxes).

2. Expenses proportional to the value of the benefits insured. (These may be assumed to be in proportion to the pure premium.)

* See, however, "Proceedings of the Joint Conference on Workmen's Compensation Insurance Rates, 1915;" published by the New York State Insurance Department, 1916; pp. 24–26.

Also, Frank E. Law, "A Method of Deducing Liability Rates," Spectator Co., 1908, pp. 19–21.

3. Expenses proportional to the amount of the insured payroll. (These constitute a constant addition to the pure premium.)

4. Expenses proportional to the number of policies issued. (These constitute a constant charge per policy.)

Under existing methods of underwriting we can go no further than to allocate expenses as accurately as may be to one of the first three groups: to utilize the fourth group, comprising those items of expense proportional to the number of policies issued, it would first be requisite that an actual policy fee or charge per policy be introduced in the computation of the premium. But without introducing any innovation in underwriting practice it is entirely feasible to assess expenses with greater regard for their sources by first distributing the actual expenses of the business, item by item in due proportion, among groups one to three inclusive. In actual practice the amount and distribution of expenses will, of course, vary considerably from state to state, making separate treatment for each state advisable.

The following allocation of expenses, adopted mainly for purposes of illustration, is based upon an analysis of the expense ratio of representative stock insurance companies for the year 1914 as reported in the *Proceedings of the Joint Conference, 1915*. The analysis represents average conditions for a number of important states and more recent studies indicate that the figures continue to reflect current conditions with considerable fidelity. Upon this basis it is assumed that the premium dollar is divisible into 60 cents for losses and 40 cents for expenses, as reported by the Conference. Personal judgment has been resorted to in subdividing the various items of expenses into three groups as shown below. It should be borne in mind that the figures given represent percentages of the gross premium in every case.

ALLOCATION OF EXPENSES (A).

(1) Division of Expense.	(2) Total.	(3) Proportional to Gross Premium.	(4) Proportional to Pure Premium.	(5) Proportional to Payroll.
1. Acquisition	17.5	17.5	0	0
2. Payroll audit	2.0	0	0	2.0
3. Administration	7.0	0	5.0	2.0
4. Inspection and prevention	4.0	0	2.0	2.0
5. Adjustment	7.0	0	7.0	0
6. Taxes	2.5	2.5	0	0
Total	40.0	20.0	14.0	6.0

A certain part of the audit, administration and inspection expenses are in point of fact proportional to the number of policies issued. Since, however, we have ignored for the moment this factor in the assessment of expense, we must distribute such charges as equitably as possible between the pure premiums and the payroll.

Acquisition expense, consisting wholly of the customary 17½% commission or brokerage, is wholly allocatable to the gross premium since it is as a percentage of such gross premium that such commission or brokerage is payable.

Payroll audit expense has been treated as wholly chargeable against the amount of payroll to be audited.

General administration, which includes such items of overhead expenses as home office salaries, rent, postage, supplies, etc., has been allocated in the proportions two sevenths to payroll and five sevenths to pure premium. It would appear 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.

The cost of *inspection and the prevention of accidents* has been equally divided between the pure premium and the payroll on the theory that the size of a plant is largely measured by the number of employees, or, what is nearly the same thing, by the amount of the payroll, rather than by the amount which it is necessary to pay for insurance. On the other hand, inspection of a more hazardous plant is more costly than inspection of a less hazardous one, and hence a part of the cost of inspection should be assessed against the value of the hazard.

Adjustment expenses have been allocated against the pure premium since the value of the claims to be settled may be assumed to be in this proportion.

Taxes have been included as proportional to the gross premium since most of the taxes payable by insurance companies are levied upon the premium income.

Finally, then, we reach the conclusion that on the basis of the foregoing analysis, 50% of expenses should be assessed against the gross premium, 35% against the pure premium and 15% against the payroll.

Now let

P = gross premium (manual) rate per \$100 payroll,
p = pure premium rate,
a = a percentage of the gross premium rate,
e = a percentage of the pure premium rate,
k = a constant per \$100 payroll.

Then

$$P = \frac{p(1+e)+k}{1-a}. \qquad (A_1)$$

In order to determine the value of the constants in this formula upon the basis of the Allocation of Expenses (A) we proceed as follows:

From column (3) we can directly take the value $a = .20$.

From column (4) the expenses proportional to the pure premium amount to 14% of the gross premium. But the pure premiums average (100 — 40)% or 60% of the gross premiums. Hence 14% of the gross premium is equivalent to (14 ÷ 60)% or 23.3̇% of the pure premium. That is, $e = .23\dot{3}$.

From column (5) we ascertain that expenses proportional to payroll amount to 6% of the gross premium. To determine k, therefore, we should first ascertain for the particular state under consideration the average gross rate per \$100 payroll. This might be found from Schedule Z, where available, by dividing the total losses incurred for the state after loading by 66⅔%, or by whatever other percentage might be required to produce the aggregate expense fund decided to be necessary, by the total payroll exposure. If, for example, the average gross rate for the state should prove to be \$1.20, then k equals 6% of this amount or 7.2 cents. That is, $k = .072$.

Substituting in formula (A_1)

$$\begin{aligned} P &= \frac{p(1+.23)+.072}{1-.20} \\ &= 1.25(1.23p + .072) \\ &= 1.54p + .09 \text{ (very nearly).} \end{aligned} \qquad (A_2)$$

In other words, the loading for expenses under the foregoing assumptions is equivalent to 54% of the pure premium plus nine cents per \$100 payroll. The aggregate expense fund thus provided

is intended to be the same as though the pure premiums were loaded by a flat percentage of 66⅔.

In order to show the differences in results produced by using formula (A_2) in place of the usual flat percentage the following short table is presented. Column (1) shows the pure premium rate; column (2) shows the gross premium rate as produced by the formula; column (3) shows the gross premium rate on the basis of 66⅔% loading with no payroll constant; and column (4) shows the difference between the two gross rates.

COMPARISON OF GROSS RATES
($P = 1.54p + .09$).

(1) p.	(2) P.	(3) $1\frac{2}{3}p$.	(4) Difference (2)−(3).
.05	.167	.083	.084
.10	.244	.167	.077
.25	.475	.417	.058
.50	.860	.833	.027
.75	1.25	1.25	.000
1.00	1.63	1.67	− .04
2.00	3.17	3.33	− .16
5.00	7.79	8.33	− .54
10.00	15.49	16.67	−1.18

It will be observed from this comparison that the general effect of an allocation of expenses upon the basis of a more nearly exact analysis of actual conditions will produce loaded rates considerably higher, proportionately, for the classifications where the basic pure premium is low and considerably lower for the classifications where the basic pure premium is high. For the medium-rated classifications the results of the two methods are almost identical.

It should be noted that in the foregoing discussion the pure premium referred to is not intended to mean the pure premium derived from available experience without modification, but represents the pure premium after proper modification for such factors as increasing or decreasing industrial activity, the age of the compensation act, the effect of schedule and experience rating, the catastrophe hazard, and the like—that is, the entire probable value of the benefits insured.

The next step in the direction of a more accurate and equitable assessment of the expense burden involves the introduction of the fourth division of expenses hitherto referred to—namely, those

expenses which constitute a fixed charge per policy and are proportional to the number of policies issued. The imposition of a constant charge per policy—known generally as a policy or entrance fee—is a very ancient insurance device and one which may well be revived in connection with workmen's compensation insurance. It is recognized that such a suggestion, if put into effect, will call for some slight modifications in underwriting practice in the field and home office. Assuming that such modifications were made and that it is therefore possible to take this fourth division of the expenses into practical account, we may proceed to a reallocation of expenses upon this basis as follows:

ALLOCATION OF EXPENSES (B).

(1) Division of Expense.	(2) Total.	(3) Proportional to Gross Premium.	(4) Proportional to Pure Premium.	(5) Proportional to Payroll.	(6) Proportional to Number of Policies.
1. Acquisition	17.5	17.5	0	0	0
2. Payroll audit	2.0	0	0	1.0	1.0
3. Administration	7.0	0	3.0	2.0	2.0
4. Inspection and prevention	4.0	0	2.0	1.0	1.0
5. Adjustment	7.0	0	7.0	0	0
6. Taxes	2.5	2.5	0	0	0
Total	40.0	20.0	12	4.0	4.0

In (B) the general basis of apportionment is the same as in (A) save that a certain part of the expenses in items 2, 3 and 4 has been assigned as being in proportion to the number of policies. In order to effectuate this distribution of expenses in practice, it is clear that we shall no longer have the simple relation

$$\text{Gross premium} = \text{gross rate} \times \text{payroll},$$

but the more complicated relation

$$\text{Gross premium} = \text{gross rate} \times \text{payroll} + \text{a constant}.$$

Adopting the same notation as before with the additional symbols

$$W = \frac{\text{Insured payroll}}{100}$$

$$P' = \text{Gross premium}$$

$$f \text{ and } f' = \text{constants per policy}$$

we shall have

$$P' = PW + f$$

$$= \frac{W[p(1+e)+k]+f'}{1-a}. \qquad (B_1)$$

In order that the aggregate expense fund may be the same as before it is necessary to redetermine the value of the constants on the basis of the percentages in scheme (B).

From column (3) we take, as before, the value $a = .20$.

From column (4) the expenses proportional to the pure premium amount to 12% of the gross premium. This is equivalent to $(12 \div .60)\%$ or 20% of the pure premium. That is, $e = .20$.

From column (5) it appears that expenses proportional to payroll equal 4% of the gross premium. Assuming the average gross rate to be \$1.20, the same as before, we have $k = .04 \times 1.20 = .048$.

From column (6) we find that expenses proportional to the number of policies amount to 4% of the gross premiums. That is, to determine f' it is necessary to take 4% of the total premium volume in the experience considered divided by the number of policies. This is equivalent to 4% of the average gross premium (*not* gross premium rate). Assuming the average premium per policy for the state under consideration to be \$125, $f' = .04 \times 125 = 5.00$.

Substituting in the formula

$$P' = \frac{W[p(1 + .20) + .048] + 5.00}{1 - .20} \qquad (B_2)$$

$$= W(1.50p + .06) + 6.25.$$

Expressed in words, the loading for expenses provided in formula (B_2) is equivalent to 50% of the pure premium plus six cents per \$100 payroll plus \$6.25 per policy. The aggregate expense fund thus created is intended, as before, to be the same as though the pure premiums were loaded by a flat percentage of $66\frac{2}{3}$.

The following table shows, for certain selected values of the variables, the results produced by formula (B_2) as compared with the results of the usual flat percentage loading.

It will be observed from this comparison that the general effect of using formula (B_2) is to produce relatively high premiums for very small payrolls and low-rated classifications and proportionately lower premiums for large payrolls and high-rated classifications. Thus, to take two examples, where the payroll is \$500 and the pure premium 5 cents the gross premium required by the formula is \$6.93 as compared with 42 cents on the basis of a flat $66\frac{2}{3}\%$ loading. Where the payroll is \$50,000 and the pure premium \$2.00 the gross premium is \$1536.25 as compared with \$1667 on the basis of a flat $66\frac{2}{3}\%$ loading.

COMPARISON OF GROSS PREMIUMS

$(P' = W[1.50p + .06] + 6.25)$.

	$W = 5$.			$W = 50$.			$W = 500$.		
(1) p.	(2) P'.	(3) $1\frac{1}{2}pW$.	(4) Difference (2)−(3).	(5) P'.	(6) $1\frac{1}{2}pW$.	(7) Difference (5)−(6).	(8) P'.	(9) $1\frac{1}{2}pW$.	(10) Difference (8)−(9).
.05	6.93	.42	6.51	13.00	4.15	8.85	73.75	41.50	32.25
.10	7.30	.84	6.46	16.75	8.35	8.40	111.25	83.50	27.75
.25	8.43	2.09	6.34	28.00	20.85	7.15	223.75	208.50	15.25
.50	10.30	4.17	6.13	46.75	41.65	5.10	411.25	416.50	− 5.25
.75	12.18	6.25	5.93	65.50	62.50	3.00	598.75	625.00	− 26.25
1.00	14.05	8.35	5.70	84.25	83.50	0.75	786.25	835.00	− 48.75
2.00	21.55	16.67	4.88	159.25	166.70	− 7.45	1536.25	1667.00	−130.75
5.00	44.05	41.65	2.40	384.25	416.50	−32.25	3786.25	4165.00	−378.75
10.00	81.55	83.35	−1.80	759.25	833.50	−74.25	7536.25	8335.00	−798.85

Insurance under workmen's compensation laws involves policy contracts covering an enormous range of risk, from the small employer desiring to insure the hazard of a single employee—who may not even be working full time—up to a great corporation with thousands of employees where the premium on a single risk may be measured in tens of thousands of dollars. Under such conditions it is difficult to find a simple basis of loading which will be equitable for risks of all sizes. Rules of thumb break down when compelled to stretch over so wide a range of conditions. Expense loadings adequate for the small risks become so large proportionately when applied to large corporations that many are driven to self-insurance. *Vice versa,* premiums involving what would be a reasonable expense loading for a very large risk might be quite insufficient to take care of the risk of an employer with only two or three employees. Especially has the compulsory or virtually compulsory nature of compensation laws emphasized the difficulty of collecting from the immense number of small employers compelled to insure an adequate premium for the risk, considering the high cost of properly auditing, inspecting and administering business in such small units, without at the same time promulgating rates which impose an unfair burden upon employers whose payroll is sufficient to secure a fair spread for administrative expenses and to warrant the expense of an inspection and audit.

The device of charging a minimum premium is only a partial solution of the difficulty. According to the standard manual, "a minimum premium is an expression of the lowest premium amount

for which a single risk can be written and carried for a period of one year." It is obvious, however, that under such a system of loading as that just outlined the necessity for a minimum premium is to a large extent done away with. A constant charge per policy, no matter how large or how small the premium may be, yields better practical results and is more susceptible of theoretical justification than a minimum premium. Under a policy-charge system each increase or decrease in the payroll of the risk, no matter how large or how small, is reflected in the rate in an equitable and non-discriminatory manner. This is not true of a minimum premium system.

It seems probable that any proposed change whatever in the method of providing for expenses will 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.

GROUP LIFE INSURANCE AND ITS POSSIBLE DEVELOPMENT.

BY

EDWARD B. MORRIS.

Although this subject principally involves that of life insurance, it includes so many features analogous to the underwriting of casualty insurance that its discussion may especially interest the members of this Society.

While a great deal has been written regarding it in the public press as well as in the insurance publications during the last few years, the subject has been reviewed more particularly from an economic point of view. I have attempted herein to discuss the questions involved more particularly from the insurance company's point of view and from the standpoint of the underwriter.

There is no doubt but that group insurance first appealed as a philanthropic measure. The employer desired to render a service to the employee that might in a measure relieve the sufferings of his dependents in event of his death. There is no question but that group insurance involves this feature to a considerable degree. Employers who purchased group insurance from this motive, however, soon found that a closer relationship was established with the employee; the wife of the employee realizing that termination of employment meant the termination of the insurance, consequently used her influence towards his continued employment. If the insurance was arranged to provide an increase with years of service, an added inducement to remain was established. The result in brief was that the cost of the turnover of employees—the replacing of experienced workmen by inexperienced—was found to be considerably decreased and that in a great many cases the saving from this source alone considerably more than outweighed the cost of the insurance. In other words, group insurance produces a decided commercial advantage and it is upon this that its popularity in a large measure rests to-day.

The insuring of employees by or through the employer is not of recent origin. The files of most insurance companies will prove that

a great deal of time has been spent on problems that pertain to this subject—time very poorly spent if the premium return were considered. Such insurances originally involved the issuance of individual contracts with examination. The cost invariably proved to be more than the employer cared to stand and most of such propositions remained in the correspondence files of the companies.

It was not until the idea of group insurance as we now generally understand it on the One Year Renewable Term plan was crystallized through an inquiry of Montgomery Ward & Company of Chicago that the present development of the business began. Montgomery Ward & Company in 1910 had considered the insuring of their employees and had for this purpose employed an actuary but finally had come to the conclusion that the matter could best be handled by an insurance company. As historical evidence the following extract from a letter from the then manager of The Travelers Insurance Company's branch office at Chicago, dated October 14, 1910, in reference to the proposition requested by Montgomery Ward & Company is submitted:

"The form of policy asked for is yearly renewable term form, each employee's insurance to be canceled upon the termination of service. The premiums are to be paid by the firm annually in advance, and allowance for the unearned premium, on account of the termination of service, to be made by The Travelers in adjusting the next annual payment.

"In considering the elimination of a medical examination, these facts should be borne in mind—that the ages of the employes run from 15 to 60 years; – – – –. The average age is — years, and the average weekly salary is $———."

As far as I know, this is the first recorded request of an insurance company for group insurance as we now know it.

I was rather interested in recently reviewing the company's files in connection with this case to note that the case was then considered on the One Year Renewable Term plan, without medical examination, and the premium first quoted was based upon the American Table with a loading of 25 per cent. which involved a commission of 10 per cent. the first year with renewals at 5 per cent. It will be evident from a further perusal of this paper that the original basis of cost was a conservative one. The company's files show also that in the fall of 1910 a group contract on the One Year Renewable Term plan in blanket form was prepared involving practically all the principal features of the present day contract.

Montgomery Ward & Company finally, in July, 1912, purchased a group insurance contract from The Equitable Life Assurance Society. This contract is generally known as the first important contract of this kind actually issued. No insurance company can rightfully claim to be the originator of this form of insurance. Its development has been one of evolution, but had its origin in the inquiries of the above mentioned firm.

Most group contracts have been issued upon the One Year Renewable Term basis. Several companies have prepared group contracts on the Ordinary Life or higher premium forms but comparatively few such contracts have been issued. One company in particular has made a specialty of writing group business on the basis of individual contracts. The cost, however, of the One Year Renewable Term contract is so low and the return so great from the employer's point of view that the development of the business has been practically limited to this basis.

The Question of Selection.—The insurance of employees as a whole was found to be impracticable if a medical examination was required of each individual. Just what experience would develop on group risks insured without medical examination was unknown at the inception of the business. Many experiments were tried but it was found that the resultant mortality by insuring all or nearly all of the active employees of a concern, with the possible exception of those very recently employed and according to an automatic formula, was surprisingly low and that such groups of lives would produce an experience comparing favorably with that produced by medically examined lives applying for individual life insurance. I am referring here to the strictly "employer" cases, that is, to contracts on which the employer presumedly pays the entire premium and where the insurance is either for one year's wage with a minimum of perhaps $500 and a maximum of $3,000, or a flat insurance to all, or else initial insurance the same to all but increasing periodically with the years of service to a certain maximum—any one of these formulas being suitable for group insurance.

It must not be overlooked, however, that the groups thus written are usually for employers whose business is prosperous and active and where the average age of employees involved is reasonably low. Experience soon showed that when the formulas outlined were departed from, the results were not as satisfactory. For instance,

were a company to write a group case on a salary basis without a maximum limit certain officials might be included with salaries of perhaps $10,000 or more, whereas the average wage of the employees probably is not more than $900; unsatisfactory results in such a case would be obtained because of the weight of the larger insurances on the officers who presumably are at an older average age. Companies writing group insurance often are requested to include officials for increased amounts. In exceptional cases a limit of $5,000 has been used by certain companies but only provided the total insurance in force justified such an amount.

A frequent form of request is that in addition to the group insurance the employee 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.

All companies writing group insurance experience a considerable demand for the insuring of associations—generally in the nature of reinsurance. Such associations usually follow assessment principles and ask for reinsurance only after their mortality has commenced to be embarrassing. While some of these, after careful investigation, may be insured, it does not seem feasible for various reasons to insure them on the One Year Renewable Term plan. The mortality, of course, might be taken care of by serious increases in premium but the main objection is on account of the increasing premium as to the individual on the One Year Term basis. Associations generally average their premiums but this involves a fallacy as apparent under a guaranteed One Year Renewable Term premium as under the assessment principle. The dropping out of the younger lives because they can obtain individual insurance cheaper necessarily tends to increase the rate on the remainder—a process which if continued is bound to bankrupt the association. The only feasible way of reinsuring associations is through level premium insurance generally on the Ordinary Life form but even in such event necessary extra premiums must frequently be charged for the heavy expected mortality. As a general rule, however, since those individuals who are able to pass medical examination can buy better and cheaper insurance individually this

plan has its weaknesses, unless the association is bound together by heavy ties or owns a considerable amount of assets, the result of past excess assessments.

Formulas of Group Insurance.—I have already mentioned the principal formulas of insurance suitable for group coverage. Any formula that is automatic and which does not over-insure nor under-insure any individual is, however, suitable.

The simplest case provides that the employer shall pay the entire premium. Group contracts are often paid for partly by the employer and partly by the employee, the entire premium however being paid to the insurance company by the employer, the employees' contributions being deducted periodically from the pay roll. The contract is made in the name of the employer.

Any plan which involves the payment entirely by the employee is to be discouraged. Where the employer pays a part and the employee a part on the Term plan the proposition is possible only provided practically all of the employees can be made to come into the plan. Such a plan generally demands compulsion through membership in an employees' association in which membership is practically necessary for employment.

In certain instances the employer provides insurance only upon married employees or those with dependents, a method which in itself constitutes a satisfactory formula.

Refinements of this kind, however, are generally to be discouraged for the reason of the complications involved. In view of the fact that group insurance can be sold generally at a cost of less than one per cent. of the total amount of insurance, the employer can afford to pay the entire premium rather than to run the risk of discriminating between different classes of employees.

Premium Rates.—When group insurance was first evolved the premiums were necessarily based on the only table available—the American Experience Table. In the beginning, these rates were rather heavily loaded because it was not known how the mortality of unexamined lives insured in groups would result but experience proved that the mortality on properly selected groups was surprisingly low.

In view of the fact that group insurance must be sold at an attractive rate, the companies involved in the business from the start have paid much lower commissions than would be paid to agents who were obliged to solicit each risk individually. It may be readily

seen that the agent is not entitled to the same consideration as to compensation as would have been the case had he been obliged to solicit each risk—furthermore, group insurance is usually sold through specially trained representatives (salaried men) from the home offices of the companies, as the selling of group insurance is usually too complicated for the average agent. The result has been that the commissions adopted by the various companies have hardly averaged as high as the remuneration which the agent would receive on the renewal of life policies, that is, perhaps 5 per cent. Furthermore, the dealings between the employer and the insurance company are generally direct, thus simplifying negotiations and avoiding a double and maybe a triple handling of many details—all of which has tended to minimize the expense item of group insurance.

Considering the mortality experienced on the non-hazardous lives and the low expense involved it soon became very evident that the gross premiums that were properly chargeable to the employer for group insurance, at least at the younger ages, were considerably less than the net premiums called for by the American experience. Therefore the companies which wrote group insurance immediately saw that the American table was not suitable as a basis for premiums. The only table in existence which seemed at all to meet the situation was 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 mortality investigations. While this table is not absolutely reliable at all ages for the purpose, in the aggregate it seems to run very closely to a proper one for the basis of group insurance where non-hazardous lives are considered. The reason for this, as I have stated, is that the experience on groups of lives properly selected does not vary greatly from insured lives medically examined. The M.-A. table was derived from the more recent experience of life insurance companies after eliminating the experience during the first few years of exposure.

The companies that have used the American Experience in the past as a basis of rates have known that the mortality involved was ordinarily considerably heavier than actually experienced and that to a considerable extent the net rates involved an allowance for expenses and for profit. 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.

On this general basis are found the rates for non-hazardous classes (we might call them the "select and preferred" classes). It is customary, however, for the non-participating companies to quote rates involving various schedules. These rates are generally differentiated by constants to provide for increased occupational hazards. A non-participating company might, for instance, use six or eight schedules depending upon the character of its business and its selection. For instance, one company might be willing to quote group rates on coal miners while another company might not care to write such a hazardous class.

The home office having obtained the necessary inspections of a concern contemplating group insurance, it is necessary that the underwriter weigh the evidence in hand and allot a rate that is suitable to the facts as known.

I have described to this point the process used in determining a non-participating rate, for the reason that the majority of the members of this Society are probably more familiar with non-participating or guaranteed rates than with the basis of participating premiums. Group insurance is offered in both ways. The rates of a participating company are made necessarily higher than those of a non-participating company in order that dividends or refunds may be granted and in order, theoretically, to provide for the safety of the rate. A participating company does not necessarily quote various schedules of rates in the way that I have described but may use only one rate schedule. Such a company might, however, combine similar risks into separate classes in order that a corresponding dividend might be paid on policies in each class. In this way the cost in several selected groups or classes might vary.

The total rate on a group of employees if divided by the total amount of insurance necessarily results in a certain average rate per thousand of insurance. This rate corresponds to the schedule of rates at a certain age. This age, however, is not the rate that would correspond to the rate at the average age of all employees for the reason of the greater weight of the higher ages. For instance, if but two risks were involved, one aged 20 and the other aged 60, the average rate would not be the rate for age 40 but probably that at about 52 to 54 according to the schedule used—because the greater weight of the risk at age 60 from the premium point of view over that at age 20. This is a point which is not always appreciated by the layman and careful explanation is often required

or very erroneous assumptions may be made. As an illustration—a certain concern asked for the cost of insurance on their employees on the basis of $1,000 insurance on each life. Later, and before purchasing the contract, they decided that the insurance should be on the basis of one year's salary and were very much surprised to find that the cost on the salary basis was considerably higher than was the cost on the flat per thousand basis, although the total insurance in the two plans was practically the same.

While the rate schedules for One Year Term insurance necessarily increase for each increase in age, experience teaches that there is very little fluctuation in the cost age for group insurance on the same plant from year to year. Of course, there is some variation on account of the change in the personnel but as the older men are more likely to die and their places filled by new employees at younger ages this difference tends to correct the increase in rate for those remaining in the employ; in other words, the change in age and consequently the change in rate per thousand in a manufacturing plant of say two or three thousand lives is very small from year to year. A concern growing very fast, taking on new employees at younger ages, may actually show a decrease in the average cost age from year to year.

A participating company in order to pay large dividends or refunds must charge a rate considerably in excess of that charged by non-participating companies. On account of the redundancy of premium the contract of such a company makes no provision as to a guarantee of rates or dividends further than to provide for the annual renewal of the contract under contract conditions. If my information is correct, a participating company under such conditions might pay dividends of from twenty to thirty per cent. dependent, of course, upon the loading in the premium. If the experience on a risk, or class of risks, is unsatisfactory it is simply a question of adjusting dividends. The non-participating company, on the other hand, offers its insurance according to a certain guaranteed schedule of rates. It is usual to guarantee this schedule of rates for a period of five, ten or perhaps twenty years according to the risk. Many employers purchasing group insurance desire that the cost of such insurance shall be known and shall be affected only by a redistribution of the lives involved. Once a contract is issued the insurance company on the non-participating plan has no alternative but to furnish the insurance for the period guaranteed, provided

the employer according to contract pays the premium therefor. There is no disadvantage involved to the employer for the reason that if the cost of such insurance is unsatisfactory it is possible for him to seek insurance elsewhere if he can find it at a lower cost, provided the original company is not in a position to voluntarily reduce its rates, although it can be said in this connection for the non-participating companies that where it has been found that the original schedule of premiums was excessive the premium schedules have usually been voluntarily reduced without regard to the guarantee in the contract to the same schedule on which new risks of the same class are assumed. This is nothing more than a proper business policy, for the insurance company which writes group insurance must adopt a policy of service to its assured.

The non-participating companies, while providing for a guarantee of rates for certain periods cannot, however, discontinue a contract at the end of such guaranteed period. They possess the power, generally, of re-adjusting the rates upward or downward as the case may be, in accordance with the experience of the class. It is necessary for the protection of the assured as well as the insurance company that some provision be made because otherwise the contracts might be perpetual in nature, which is necessarily against a proper business policy.

The guarantee of rates for various periods has been the cause of some rather peculiar arguments in the sale of group insurance—some employers insisting that the guarantee of rates for twenty years is more beneficial than a guarantee for, say, ten years. This is not necessarily the case, however, when one considers that the employer may at any time terminate his contract and purchase insurance elsewhere if he believes that such a change would produce a lower cost. The tendency of rates has been downward rather than upward in view of the favorable mortality experience resulting on such risks and as the result of better underwriting principles. A feature of more importance to the employer lies in the selection of the insurance company in the first place, that is, the importance of selecting a company which is amply able to assume its contracts and which has a favorable reputation as to service.

It is surprising what a relatively small number of group contracts have been canceled by the employer. Speaking for the company with which I am connected, out of some three hundred issued policies but two contracts have been discontinued and these for reasons which have no bearing on the desirability of the insurance.

GENERAL CONDITIONS OF THE BLANKET OR GROUP CONTRACT.

One Year Renewable Term Plan.—The one year term contract, as the name suggests, provides insurance for one year and is paid for by one annual premium (which may be paid, however, semi-annually, quarterly or monthly). When renewable the process is simply repeated—the premiums being calculated as of the age attained of each individual included at the date or anniversary of the contract. Where more than one life is included, as under a group contract, the coverage is extended to all by means of a schedule (or card system) listing the names of all individuals included with such items as the date of birth (or age), name of beneficiary, amount of insurance, a statement of formula of insurance, and, under certain conditions, period of service. The schedule automatically defines the insurance, subject generally to notification. The contract also includes a schedule of premiums at each age attained, generally stated per $1,000 of insurance. The total initial premium of the contract is simply a valuation of the premium schedules as applied to the schedule of employees (or individuals), the total rate being simply the summation of the individual costs. The contract further provides for the inclusion of new entrants and the exclusion of employees whose service has been terminated. The cost of such is usually figured pro rata. Additions and cancelations are generally based upon notification although under any automatic coverage failure of notification would not generally avoid the contract. Dependent upon the amount of insurance involved, changes in personnel might be made in weekly, monthly or at longer intervals. Premium adjustments are usually made at monthly intervals although actual payments may be deferred to the anniversary of the contract, when a yearly settlement would be made.

While the above briefly outlines the basis of the contract, the following items are generally included as a part thereof:

Insuring Clause (see above).—The laws of the several states so differ amongst themselves as to render impossible the use of the same insuring clause. Certain states, for instance, permit the payment of claims through the assured (the employer) for the benefit of named beneficiaries (perhaps named only on the certificates issued to employees), so that a claim check by the insurance company to the assured is a proper discharge of the insurance company's liability. In certain states this is impossible and the insurance benefits must be paid by check direct to the employee's named beneficiary

although the check in this event would generally be sent through the employer.

In all cases, however, payment must be made for the ultimate benefit of the employee's beneficiary or dependents. It would be questionable policy, if not actually illegal, for an employer to insure himself against the loss by death of an employee, or indeed to reinsure himself through a group life contract against losses which he might sustain through compensation benefits. At least it is doubtful whether the insurance companies would be willing to write such a contract. The benefits must eventually go to the employee's benefit.

Provision for the Payment of Premiums (How and When and Where Payable).

Provision for the Renewal of Contract.—Most of the companies provide under this clause for the guarantee of rates for a definite period, at the end of which time the premium schedule may be adjusted although the contract may be renewed. As far as I have been able to ascertain, no company actually provides for cancelation inside of fifty years. Some of the companies do not even limit the contract in this respect.

Date Effective.—This clause defines the date on which the insurance becomes effective. In view of the fact that a group contract cannot be written until all data regarding employees—name, date of birth, name of beneficiary (if necessary) is collected, it is often customary to put the insurance in force by obtaining from the employer a signed application which definitely outlines the formula of insurance and the coverage proposed, and the payment of a nominal binding premium. A notification by the proper executive of the insurance company then automatically puts the plan into operation. The obtaining of all the data necessary for the actual issuance of the contract may be a matter of weeks and perhaps months; consequently, the actual contract may not be delivered for months after the insurance has been effective and after perhaps many claims may have been paid.

Incontestability.—This clause is necessary in view of statutory requirements. It is rather meaningless in the case of a company whose contract makes no provision for suicide. As there is no more selection through suicide by employees in the first than in any other policy year, there is not the same need of including the suicide clause as in the individual insurance contract (as most contracts

provide that an employee shall have been in the employer's service for a definite length of time before reaching the insurance coverage, three, six or twelve months as the case may be). If the contract in addition provides that it shall be free from conditions as to residence, occupation, travel or place of death, and further requires no permit or extra premium for military or naval service in time of war or in time of peace (see further discussion), there is little ground on which a company could contest. The provision under these conditions is largely perfunctory.

A Provision that the Insurance shall not be Effective upon Employes under a Certain Minimum Age or perhaps over a Certain Maximum Age (the latter provision is often omitted, having little value from an underwriting standpoint in the usual employer group) and until the name of the employee shall have been added to the sechedule by the company. This last provision while necessary to the contract generally would be waived if it could be satisfactorily proved that a name or names were excluded by error or oversight on the employer's part, provided the formula for insurance which is the fundamental basis of the coverage was automatic.

Provision for the Addition and Cancelation of Individuals from Coverage.—This has already been outlined briefly but there is one further point worthy of notice. Originally termination of employment meant the cancelation of insurance. This clause obviously was too severe—if accepted literally it would mean that an employee would have practically to die with his "boots on," i. e., as the result of an accident, in order that the insurance would be payable. It left too much to the insurance company's option. The clause should properly provide for insurance benefits on those employees whose services are terminated by illness which finally results in death, maybe months after cessation of active employment and after participation in the payroll. The up-to-date clause, therefore, specially provides that the insurance as to any employee shall cease with the termination of employment except in the event that such termination shall be caused by the disability of the employee. The practice of most companies is even more liberal than this—covering employees, or ex-employees maybe, provided the employer will continue payment of premiums. As the employer will hardly continue payments voluntarily on a former employee unless there is good reason therefor, such as a temporary shutdown in work, such an interpretation on the part of the insurance companies is usually safe.

The present war has raised some interesting points in this regard, for the military situation has not been generally provided for. For instance, in this crisis it is probable that quite a few male employees, of whom many are already in the militia and many more may enter military or naval service, will cease active employment and many employers will under the circumstances desire to continue their insurance under the group plan. As the situation is a real one, each company must in the absence of definite provision determine its own position. Those companies whose policies provide for insurance until notice of cancelation is received from the employer must necessarily continue the insurance if the employer elects to continue premiums. Unquestionably the companies must treat the situation in a broad way. The question on existing contracts might be met by continuing the insurance provided the employer would continue premiums and in addition would continue such an employee on his payroll for a substantial proportion of his former remuneration, or else would equivalently provide for his dependents. New contracts will probably provide for definite provision in the event of military service.

The hazard may not actually be so severe as it may at the outset appear; first, because the average insurance coverage under group contracts is not large, probably between $600 and $700, and second, because the military hazard will apply more generally to younger rather than to older employees (the insurance coverage of such being necessarily smaller) and third, a considerable proportion of the lives insured for group insurance are industrial, mechanics who probably will not be drafted into active military service. Nevertheless, of the hundreds of thousands of employees insured under group contracts in this country many will serve under the colors. It is doubtful, however, whether the question under group policies is as imperative to the insurance companies as that involved in the billions of unrestricted insurance held under individual policies.

Provision for Deduction of Unpaid Premium Instalments in the Year of Death.—The analogy with regular insurance will be noted.

Conversion to Higher Premium Forms.—This allows the employee upon termination of service to continue an equal amount of insurance under an individual policy by personally paying the company's manual rates, granted without examination if application is made within a certain period—usually thirty-one days. This provision is compulsory in certain states in order that the ex-employee

may not be deprived of insurance through termination of service, on the ground that he may have lapsed other personal insurance when covered under the employer's group plan. Certain employers, however, have advanced the opinion that by this provision one of the arguments that induced them to purchase group insurance might be nullified and, consequently, prefer that the matter be optional with them—that they may grant the provision to deserving employees who leave their employ under certain conditions.

While this privilege offers a certain selection against the insurance company, in practice the provision is of very little importance, probably because it is the poorer class of employees whose services are terminated and these are not the ones most interested in insurance benefits.

Disability Benefits.—This provision for total permanent disability when offered is generally that offered under regular individual contracts. Some of the companies are more liberal towards women and will include them for disability benefits under group contracts when they will not do so under individual contracts, for obvious reasons.

Usual Provisions for Grace Period, Modifications in Contract, Misstatement of Age, Non-payment of Premiums, Entire Contract Clause.—These usually follow the wording prescribed under the statutes and require no special consideration here except—

Under the grace provision the employer shall pay a pro rata premium on the last grace period if notice of cancelation is not provided the insurance company.

The misstatement of age clause usually provides for premium adjustment rather than insurance adjustment where statute permits.

The entire contract clause, however, differs considerably from that in the individual contract as statements by employees are not necessarily a part of the contract. In most states employees do not actually sign application or census blanks. The question of age is covered elsewhere. Consequently, the entire contract clause may cover simply the schedule of employees as provided by the employer. This is not true of all the states, however.

Group Ordinary Life Contract.—As very few such contracts have been written an extended review is hardly necessary. Its complications and features deal more especially with the question of surrender values and the possible division of ownership.

Analogy with Compensation Insurance.—While accident insurance has for many years in the past (health insurance more recently)

been written under group contracts, group insurance as known to-day involves mainly the insurance of lives, that is, provides for the payment of benefits in event of death from any cause. An individual applying for regular life insurance must sign an application for such insurance. When group insurance is considered the signing of the application is absolutely necessary in only one of the important states—Massachusetts, although the signing of a census blank by each employee is usually expedient in order that the proper data relative to the risk may be obtained. The group term policy as written provides for insurance according to a certain formula on the lives listed in the schedule of employees or in the card file attached to the policy, as the case may be. Each life is therefore named and such important information as the date of birth given as a part of the contract. In determining the rate for a group policy the rates on the individual lives according to the schedule of premiums which is also attached to the policy are simply added to get an aggregate premium. This may seem to men versed in casualty principles a roundabout method of obtaining a rate for insurance but nevertheless it is required on account of the laws of various states, even though the contract provide for the payment of one year's wage in event of death so that the premium (once determined) is a function of the wage. Considerable thought has been expended as to whether it would not be possible on insurance based on the payroll to likewise determine the premium as a function of the payroll. It is doubtful whether this would be feasible in the long run even though it was legally possible. Group contracts provide for periodic adjustments in coverage, that is, as the employment ceases the employees automatically drop out of the insurance coverage and as new employees come within the service coverage their insurance is automatically adjusted. This means the periodic adjustment of the risk. In large cases it means considerable detail but, on the other hand, it should not be overlooked that by this method the auditing of payrolls and the expense connected therewith are entirely eliminated in the group contracts as now drawn so that the methods used may involve a possible saving in the end.

The proper method of underwriting group insurance involves certain features analogous to casualty insurance, at least to compensation insurance, which should be remarked upon. Medical examination of the individual life is omitted where the number of em-

ployees involved is in excess of a certain minimum, usually one hundred lives, and where the formula for insurance is automatic. This, however, does not necessarily fix the rate, for the employees of one plant may differ considerably as to occupational hazard from another although engaged in the same line of work. The employees of one plant, for instance, may be very much better protected against accident than those in another plant. The health conditions of one concern may be much better than in a neighboring shop through the attitude of the employer towards his employees and the insistence upon the carrying out of certain health rules, the avoidance of excessive overtime work, etc. It is essential, therefore, that every risk be very carefully inspected for physical and health hazards. This requires expert attention. An agent who ordinarily sells life insurance is not generally one who is able to make a proper inspection of this kind. Proper inspection can only be made by men specially trained in this kind of work and in this regard group insurance approaches very closely to casualty insurance involving the employees of a common employer and for this reason companies which write casualty lines in connection with life lines are much better equipped to handle the business. In the inspection of the physical risks of a factory considerable attention should be given to the health conditions of the plant. As I have already suggested, this involves the general attitude of the employer towards the employee in provision for welfare work, rest rooms, lunch rooms, proper analysis of drinking water, observation of the home conditions of employees and numerous other features of vital importance beyond the usual "Safety First" ideas of accident prevention. In this way group insurance is opening up a heretofore somewhat undeveloped field. All of these points have their effect upon the proper cost that can be quoted for group insurance.

The matter of inspection does not cease with the initial inspection of the risk. The insurance company is primarily interested in the mortality of the group of lives insured and is willing, therefore, to do what it can within reasonable limits to improve the health and working conditions of a concern on which it carries group insurance and is in a position to offer to the employer the privilege of a periodic inspection of the working conditions and the health conditions of the plant. These inspections should be made even more thorough than the original inspection, and should be properly followed by a report which not only remarks upon the conditions as

found but also upon possible improvements. This service is necessarily optional with the employer. It cannot be forced upon the employer by the insurance company at the present time but the plan is so reasonable that the employer in the majority of cases will readily acquiesce in such an inspection and will take advantage of the recommendations made, especially if he feels that the recommendations if followed will result in the improvement of the health of his employees and the consequent reduction in the death rate, which in turn involves finally a reduction in the cost of insurance.

By-Products of Group Insurance.—As I have already stated, group insurance is sold to a considerable degree by special representatives from the home office of the company—for the reason that the selling of group insurance requires special training which comparatively few insurance agents possess. For reasons already mentioned, the remuneration to the agent from a percentage point of view is small as compared with the usual ratio of commissions offered for the solicitation of individuals. The argument has arisen, therefore, from certain sources that group insurance is unfavorable to the agent in possibly robbing him of the chance to write individual employees of a concern. This argument, to say the least, cannot be backed up by facts for the reason that once a group contract has been written on the employees of a concern the agent or agents of the company writing such insurance as well as the agents of other companies possess an entrée for the writing of additional insurance which they did not previously possess. Statistics have shown that altogether too low a percentage of employees carry adequate insurance, or any insurance at all. The fact that group insurance is carried on the lives of the employees of a certain plant results in their education towards insurance; the payment of claims on deceased employees is naturally generally known, and the attitude of the employees towards insurance is consequently very much changed. The agent receives the opportunity to interest such employees in further insurance on individual contracts. Group insurance as sold to the employer very seldom involves an insurance of more than one year's wage which necessarily invloves an amount in the ordinary case very much under the adequate protection, so that the agent should have very little difficulty in supplementing such insurance through personal solicitation.

For example, a systematic following up of employees insured under a certain comparatively large group contract by a single agent

resulted in one year in the issuance of regular business amounting to some $800,000.

Discussion of Certain Legal Features.—The insurance laws of the various states have been based mainly on the issuance of policies to individuals and, consequently, in many respects are not adapted to blanket or group policies. At the present time only a few states have passed special legislation applicable to group life insurance. The insurance departments of the various states, however, as far as compatible with existing laws have been liberal in decisions affecting group insurance. In certain states where the laws specially provided that no insurance be issued without medical examination, it has been necessary that special legislation be passed in order to permit the writing of group insurance without examination. In such legislation it has been necessary to define group insurance. The general definition adopted has been the insuring of the lives of more than one hundred employees of a common employer. New York has exempted group insurance along these general lines from the limits of new insurance which may be issued. While smaller groups under certain circumstances can be written, usually individual medical examination is required and the business must be included in the regular business limits.

While it is still possible to write groups of lives other than employees of a common employer such business is usually not exempt. The business of most of the companies writing group insurance at the present time, however, involve groups under a common employer wherein the employer is interested to the extent of contributing all or a major part of the cost of such insurance. None of the companies are reinsuring fraternal orders at the present time nor are they likely to in the future.

A very interesting point has arisen on account of the inadequacy of existing laws as affecting group insurance. The laws of a number of the states provide for valuation based upon the American Table. With these laws the insurance companies have strictly complied irrespective of the basis of premium. The laws of at least two states, however, provide that if the premium charged for insurance shall be less than the net premium according to the standard adopted by the state for valuation purposes, the insurance company shall be obliged to set aside a special deficiency reserve equivalent to the deficiency in premium multiplied by the present value of an annuity for the period over which such premiums are pay-

able. As I have heretofore pointed out, group insurance if the occupation hazard is slight may be offered at gross rates at the younger ages under the net premium according to the American Table. Those states which have passed legislation as above described have naturally demanded a special deficiency reserve of the insurance company. Commissioners of certain other states have ruled to the same effect, so 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. While these deficiency reserves affect generally the younger ages only, it is possible to cite a case where an insurance company which receives a gross premium of perhaps $7.00 per thousand is obliged to put up not only one half the net premium according to the American Table in accordance with the valuation laws, but in addition deficiency reserves on such a risk of maybe $30, so that as far as the particular risk is concerned, for a gross premium of $7.00 the insurance company puts up total initial reserves of perhaps $35 besides paying expenses incidental to the business. It will be readily seen by such a ruling that a recently organized company or an insurance company with a relatively small surplus would not be in a position to write group insurance under existing conditions. The situation is somewhat peculiar when one considers that the rates charged by the insurance companies are properly loaded for profit as well as for expenses and, in fact, may be producing yearly profits.

This point emphasizes one need of a proper mortality table as a legal basis for reserve valuation. The insurance commissioners recently requested the Actuarial Society of America to prepare a table which will represent the proper mortality on American insured lives. Certain companies have already furnished data for this purpose and a report will undoubtedly be made in the comparatively near future. The adoption of such a table as a legal basis for valuation is necessarily a slow process if finally recommended by the insurance commissioners. As group insurance, however, has already emphasized its value in the cutting down of turnover costs of employees and in stabilizing employment, as evidenced by the approval of probably the majority of employers who are carrying such insurance, it is undoubtedly a permanent institution. While the insurance companies are not wont to charge the employer a premium greater than is necessary to meet mortality costs and nec-

essary expenses and contingencies, disregarding entirely the question of valuation which has no direct bearing on the actual mortality cost to the companies, it is hoped that the necessary steps can be taken to insure proper and adequate legislation.

The fundamental assumption upon which a deficiency reserve is required involves the question of sufficiency of rate. As applied, however, to the present statutes and rulings, this assumption may be questioned for the following reasons:

1. Upon the supposition that the American Table is the proper one for the basis of group insurance rates. I think I have stated enough to show that on non-hazardous risks at least, gross premiums at the younger ages can be safely quoted at lower rates than those demanded by the net American Table. To insist, therefore, upon the use of the American Table as a basis of group rates would act as a preventative towards the sale of group insurance.

2. The assumption involves an unjust discrimination between classes of risks. For example, let us compare the results between a policy for office employees only which involves no occupational hazard, and a group composed entirely of locomotive engineers which does involve occupational hazard. We will assume that the rate on the latter class is such as to call for a gross rate in every instance above the net American premium, and yet on such a class no deficiency reserve would be required, whereas a considerable deficiency reserve would be required for the non-hazardous class, yet from an underwriting point of view the locomotive engineer class might involve the insurance company much more seriously than would the group of office employees. I make this illustration in order to call attention to the fact that the deficiency reserve idea as now applied to group insurance is a hindrance rather than an aid to proper underwriting. Someone may advance the argument that I have specialized too greatly in the illustration which I have made and that while the deficiency reserve may not affect all risks it provides as a whole a certain margin of safety. This argument I judge not to be a sound one, for the reason that a company might assume none except hazardous risks which would involve no deficiency reserve and, consequently, no further protection than that contained in the rate itself.

3. The requirement involves an unjust and unnecessary distinction between participating and non-participating business. A participating company, for instance, might quote a gross rate equal

to or greater than that required by the American Table yet on non-hazardous classes might easily declare dividends which would reduce the net cost of the insurance to, let us say, 90 per cent. of the American Table. A non-participating company, on the other hand, quotes a schedule which guarantees a rate of, let us say, 90 per cent. of the American Table. The costs to the employer in the illustration I have made are identical, yet the non-participating company is required to set aside a considerable deficiency reserve which is not required of the participating company through the technical construction of the law or ruling. Of course, it may be argued that a participating company need not set aside a deficiency reserve in view of the redundancy of their rate and the option they possess of decreasing dividends. That argument must be set aside as theoretical only when the *facts* of the situation are carefully reviewed, for when it comes to the question of safety the non-participating company is safeguarded by capital and excess surplus accumulations which are not permitted to the mutual company.

I have not intended in this explanation to advance an argument for or against the various classes of insurance companies but have used the illustration simply in relation to the deficiency reserve idea.

Some peculiar agency difficulties have arisen through the sale of group insurance which illustrate certain legal phases which had not been foreseen. The business of an employer may involve the employment of men and women in many states, especially where a sales organization may spread out into perhaps nearly every state in the Union. Many states have special resident agency laws and problems on this account have arisen. Special care should be taken, therefore, in handling this rather complex problem. As an illustration, let us assume an employer incorporated in the State of New York with branch offices in Ohio, in Massachusetts and in Canada. The branch office in Massachusetts we will say has eighty employees. The difficulty involved is this: Ohio not only has a very strict resident agent's law but especially provides for statement of beneficial interest. The laws of Massachusetts exempt without examination group insurance upon employees of a common employer only provided more than 100 risks are involved. The laws of Canada at the present time do not provide for the writing of group insurance under any circumstances. And yet, the employer at the head office in New York is willing to pay for the entire

premium in New York and asks that the contract be written in New York. The problem is somewhat further complicated by the fact that in Massachusetts it is impossible to extend the coverage to new employees under an existing contract. It is necessary in order to cover new employees to cover same by the issuance of additional contracts—the decision in Massachusetts being peculiar in this regard. I shall not here attempt to solve this problem but have recorded it only to point out an example of possible problems which may present themselves due to the fact that we have no general insurance laws.

The Limit of Risk.—The question has been asked why it would not be possible for a good sized concern to carry its own insurance on its employees rather than insuring them in an insurance company. As this question deals with some of the fundamentals of the business I will attempt to discuss it. There is no question that a concern whose employees number perhaps ten to twenty thousand could from a financial point of view run no particular risk in carrying its own insurance but the reasons against such a procedure are as follows:

The concern in question is not in the insurance business and to properly carry its own risk would need the advice at least of experts as well as to assume the expense of keeping necessary records. As I have noted above, no company should assume a liability of this kind before putting aside the proper reserves in order that the cost may be actually determined from year to year.

Unless the concern is a very large one, the expense connected with the carrying of such business added to the actual cost of the business will ordinarily show a very small saving over the cost of purchasing the insurance from an insurance company. Nor can the calamity hazard be entirely neglected. The possibility of the loss of lives through a conflagration, through explosions, etc., should not be overlooked. The loss of the "Eastland" in Chicago a few years since also illustrates the point at issue. Here a steamer carrying a field day party of the employees of a certain concern was sunk and many lives lost. Necessarily no concern should hazard in any way its surplus through the assumption of a considerable insurance risk. Perhaps the most important feature, however, is the moral effect of insurance through an insurance company—the entering of a third party. If a concern is carrying the insurance itself it necessarily must make its own claim adjustments, especially if accident and

health insurance are involved. This involves a possibility of dissatisfaction oftentimes and the benefits derived from an insurance feature may be to a considerable extent nullified by the resulting criticism. If the insurance is placed in an insurance company the responsibility for adjustments necessarily rests with the claim adjusters of the insurance company and any criticism is naturally directed against the insurance company rather than against the employer. Then again, better and more satisfactory results will be obtained through the insurance company whose representatives are specially trained in their various duties.

POSSIBILITIES OF THE FUTURE.—At the present time it is doubtful whether over 1,000 group contracts have been written in the United States out of hundreds of thousands of employers who might be interested. Practically all of the group insurance which has been issued has been on the basis of the One Year Renewable Term plan which, as I have already stated, is the simplest form possible. A very, very few blanket contracts have been written upon higher premium forms such as Ordinary Life although such contracts have been issued. From the employer's point of view there is no doubt but that as a preliminary step group insurance on the One Year Renewable Term plan is the most desirable but in my opinion group insurance will not cease with the sale of the One Year Renewable Term policy but is opening up a field which is scarcely appreciated at the present time. While I am not going very far into this subject at the present time, for it is a vast subject in itself, the following statements are offered as indications of the possible development of this business. Usually the One Year Renewable Term policy is paid for entirely by the employer. This is not always the case, however, and a great many contracts have been sold in which the employee shared with the employer in contribution. While this phase opens up certain difficulties, the part payment plan by the employee is possible and practicable provided provision is made whereby a large percentage of the employees are involved.

There are various phases of treatment of the part contribution plan. The employer, for instance, may agree to pay 50 per cent. of the premium charge as to any individual at the end of say, one year of service; 75 per cent. at the end of three years of service and 100 per cent. at the end of five years of service—the argument, of course, being to attract the employee to remain in service.

Under certain conditions the employer may agree to pay half the premium and the employee the other half, pointing out to the employee in this connection that he is enabled to offer to him insurance at a cost far below that which he can obtain individually.

The part contribution plan is much better fitted to the sale of higher premium policies generally by the issuance of individual policies. Numerous plans have been devised to meet this situation. By this means it is possible to provide for a pension feature to employees. For instance, let us assume the issuance of an individual contract providing insurance to a retirement age and at such age convertible into an income for life.

The contribution by the employer may be arranged in various ways, of which the following are suggested:

1. On a "fifty-fifty" basis.

2. On a basis where the employer's contributions increase with years of service—the contributions of the employee decreasing to correspond.

3. Or the employer might take out a group contract on the one year renewable term plan which as to any individual could be converted without medical examination into such a pension plan as described above. As to any individual the contribution by the employer naturally increases from year to year with the advance in age of the employee until a point is reached where the employer's contribution is sufficient to pay the entire premium on the pension policy—of course, beyond this point the employer's contribution will not increase. The employee, on the other hand, will pay a decreasing premium from year to year, finally nothing, yet when the retiring age is reached the employee will receive an annuity payable as long as he lives with certain provision in event of his death beyond the retirement age to his beneficiary should she survive. In event of the death of the employee during service the entire insurance value of the contract is turned over to the employee's beneficiary or dependents.

Under these conditions it will be noted that while the employer is paying the cost of the insurance the employee is carrying the investment part of the contract of which we may assume he will receive full control in event of termination of service provided he then assumes the entire premium charge. While in service, however, it is recommended for obvious reasons that a loan on the policy be granted to him only with the joint consent of the employer.

Back of all these plans which I have mentioned is the underlying thought of stability of labor. As has been stated, group insurance on the One Year Term plan has already been proven a stabilizer of labor, but under the plans which are described above the desire on the part of the employee for continuation in service will he enhanced for the reason that he obtains a very favorable investment through the employer's coöperation which he would lose as to the future were he to terminate such employment, and all this at a cost to the employer which perhaps may be less than one per cent. of the yearly pay-roll.

There is one complication which should be mentioned in this connection, the question of ownership of the policy. Individual contracts have been issued on groups of employees wherein the employer has paid the entire premium, that is, on higher premium forms than Term insurance, the employee assigning to the employer the surrender value of the contract to be effective in event of cessation of service, the employer guaranteeing, on the other hand, that in event of death in service the entire insurance proceeds of the contract shall be paid to the employee's beneficiaries and that upon the attainment of a certain age the entire proceeds of the contract shall be surrendered to the employee.

Under the joint contribution plan the question of ownership is not as simple and special assignments are necessary. For instance, as under plan number one, if the employee and the employer contribute equally an assignment might be worded whereby upon termination of employment the employer would release his ownership in the contract to the employee provided the employee would reimburse the employer for one-half the surrender value of the contract. Incidentally, a proposition which has met with some favor and argument along these lines involves the gradual giving up by the employer of his interest in the contract, that is, increase in years of service means an increase in the ownership of the policy on the employee's part provided, of course, service is continuous.

I need not call to your attention the investment possibilities of these general plans for the employee as a result of the employer's contribution. Along the lines which I have mentioned, it is possible to work out an interest return to the employee, were he to cash in his policy for its full value at the retirement age (65), which would represent an investment at a guaranteed rate of interest very

much in excess of anything that he could personally obtain. Of course, this rate is dependent upon the age at issue and upon the amount of contribution by the employer, but returns in excess of 5 and even 6 per cent. compound interest can be guaranteed. Remembering that the entire insurance value of the contract will go to the employee's dependents in event of death during service the advantage to the employer as well as the employee is easily seen.

In event of termination of employment if the employee will reimburse the employer for his contribution, he may continue his insurance provided he will assume the full payment of premiums.

I have not attempted to do more than mention in a general way this proposition but I think you will agree with me that it possesses enormous possibilities.

REVISION OF WORKMEN'S COMPENSATION RATES (JANUARY-MARCH, 1917).

BY

HARWOOD E. RYAN.

The recent revision of rates for workmen's compensation insurance should be of particular interest to the members of this Society. It is to be hoped that in due time complete details of the work will be available. In what follows, however, on account of the volume of material developed, it will be possible only to deal with the more important aspects of the subject, and in particular with those involving the application of actuarial principles.

The year 1916 is believed to have produced in this field underwriting losses of serious proportions. It is known that industrial pressure due to the war which commenced about the middle of 1915, greatly increased during 1916 and produced abnormal accident frequency. Green help, crowded factories, long hours have been contributing conditions. A survey of the situation as developed from a special inquiry instituted by the New York Insurance Department was, on December 8, 1916, presented to the companies operating in New York. It showed the following comparison of results for the two years of issue—1914 and 1915. Owing to the immaturity of the data the figures must be regarded as indicative rather than conclusive.

COMPENSATION LOSS EXPERIENCE UPON POLICIES EFFECTED IN 1914 AND 1915 —NEW YORK BUSINESS ONLY.

	Policy Year 1914.	Policy Year 1915.
Aggregate earned premiums	$13,313,559	$10,754,213
Total incurred losses	6,828,758	7,329,813
Indicated loss ratio as of September 30, 1916.	51.29%	68.16%

In the meantime, the companies themselves had become concerned with the rate situation generally and a movement was inaugurated by the National Workmen's Compensation Service Bureau to meet, by means of a general rate revision, a recommenda-

tion favoring increased rates, made by the New York Insurance Department. The membership of the bureau comprises the leading stock liability insurance companies of the country. It has not, up to the present time, admitted to membership mutual companies or other insurance carriers, although a start has been made in the direction of broadening its rules for eligibility. Recognizing that the situation called for general representation, the Bureau proposed that the Standing Committee on Workmen's Compensation Rates, appointed in March, 1916, by the Massachusetts, Pennsylvania and New York Insurance Departments, should be designated to undertake the work. This arrangement was finally made, the membership of the standing committee, however, being increased for the purpose from seven to eleven. As finally constituted the committee consisted of the following members:

American Mutual Liability Insurance Company,
Employers Liability Assurance Corporation,
*Employers Mutual Insurance Company,
Fidelity & Casualty Company,
Globe Indemnity Company,
Massachusetts Employees Insurance Association,
Maryland Casualty Company,
*Millers Mutual Casualty Insurance Company,
New York State Insurance Fund,
Travelers Insurance Company,
*Utica Mutual Compensation Insurance Corporation,
New York State Insurance Department (chairman).

This arrangement gave to stock company representation five votes, to mutuals four, to the State Fund one. The chair voted only in case of tie.

The committee proceeded to create an actuarial sub-committee, to which appropriate subjects were referred for research and report to the standing committee, as follows:

American Mutual Liability Insurance Company,
Fidelity & Casualty Company,
Massachusetts Employees Insurance Association,
New York State Insurance Fund,
Royal Indemnity Company,
Travelers Insurance Company,
Massachusetts Insurance Department (chairman).

* These three considered as two for voting purposes.

On the part of the National Workmen's Compensation Service Bureau it was stipulated that the revision should be expeditiously conducted and completed and also that the sessions be held at the offices of the Bureau in New York where the facilities for a work of such character were at hand.

The difficulties encountered were largely technical and non-competitive and the general atmosphere of the conference was harmonious and co-operative. A resolution was adopted providing: "that as soon as the present work of rate revision is completed, this committee proceed with the development of plans calculated to produce statistical information which will serve as the basis for an exact determination of all collateral questions relating to rate making, the committee to meet for such time as may be necessary to determine these issues, the results of their conference to be transmitted to the various insurance departments and bureaus interested."

The 1915 conference established basic pure premiums for the classifications (numbering about 1,300) contained in the compensation manual. With some exceptions, due to local conditions, the rates based thereon were put into effect in various states during the first half of 1916. It now appears that this action lagged behind the changed conditions brought about by the European war and that a higher rate scale should have been sooner adopted. Industrial pressure began to be felt about the middle of 1915 and was in full swing by the first of July, 1916.

The rates produced by the 1915 conference may be said to represent the first efforts made to combine experience data of several states. Earlier rates were chiefly conjectural and were determined almost wholly from Massachusetts and New Jersey data. The original rates for New York and for other states which adopted compensation laws between the summer of 1914 and the fall of 1915, come within this designation.

The work of the recent conference resolved itself into the following separate activities:

1. The application of an increase to the existing level of rates for the purpose of producing general adequacy of premiums.

2. A readjustment of the basic pure premiums with a view to minimizing inconsistencies due to earlier errors and lack of adequate statistical data.

3. Revision of manual rules wherever necessary to bring about

further standardization of procedure and to provide for improved methods of underwriting special hazards.

Items 2 and 3 were accomplished by the principal committee, the actuarial subcommittee furnishing the data in form for use in determining pure premiums. Item 1 was the subject of an extended study, by the subcommittee, which formed the principal basis for the new rates.

Combination of Experience Data.

The first problem presented involved the question of reducing the experience data, derived from several states with compensation laws of varying durations and having unlike benefit schedules, to a common basis. The discussion which developed over this question brought out widely differing views. Finally, after several suggested methods had been exhaustively debated, it was voted to proceed as follows:

Using the Massachusetts Act of 1912 as the standard, law differentials were computed with reference to the Standard Accident Table of Dr. Rubinow. Taking these as divisors, the actual losses for each state were reduced to the basis of the Massachusetts Act of 1912. These divisors and the corresponding reciprocals are given in the subjoined table along with the aggregate experience data available for each state. Special factors introduced for New Jersey and Illinois are in recognition of the absence of administrative control of claim settlements in those states.

State.	Reduction Factors.		Reciprocals.	Data Available.	
	Proposed Divisors.	Special Factors.	(Reduction Multipliers).	Payroll.	Losses.
Michigan	1.04	.....	.961538	$ 298,665,450	$ 1,780,423
New Jersey	.97	1.10	1.134021	326,826,653	1,376,179
Illinois	1.37	1.05	.766423	477,725,599	2,982,212
Connecticut	1.27	.....	.787402	87,947,831	394,586
Iowa	1.12	.....	.892857	36,451,041	164,078
Minnesota	1.18	.....	.847458	85,166,975	513,115
Rhode Island	1.01	.....	.990099	26,750,819	159,255
Wisconsin	1.60	.....	.625000	85,740,671	669,827
California	1.66	.....	.602410	209,963,040	1,498,126
New York	1.89	.....	.529101	1,131,304,828	6,574,951
Massachusetts, Part I.	1.00	.....	1.000000	1,212,533,164	4,755,663
Massachusetts, Part II.	1.40	.....	.714286	362,468,715	1,958,867
Total	.....	.....	.....	$4,341,544,786	$22,827,282

The procedure above indicated having been recommended by the actuarial committee, it was adopted by the conference. Mr. Albert H. Mowbray, who served on both committees, presented a dissenting report in which he contended for the employment of reduction factors derived from actual experience rather than from the standard accident table and for recognition of the principle that the law differential, instead of being constant for all classifications, should reflect the expectation of each type of loss provided for in the pure premium. This would have required an analysis of the pure premiums by type of benefit and the establishment of a differential representing each. Although the committee rejected this theory, the controversy which its introduction has stimulated is an indication that it has other sponsors and that it will in future be given further consideration.

In a brief review of this kind it is impossible to enter into a full discussion of the various factors which enter into the final multipliers developed for passing from the basic pure premiums to the rates for particular states. It will be sufficient to show what these elementary values are and the principles which they seek to recognize. The law differential is well understood and need not be further described.

Underestimates of Outstanding Losses.

After a careful review of this subject by the actuarial committee and upon its recommendation, the conference established a factor for underestimates equivalent to 2 per cent. of the incurred losses. Upon this point the reasoning of the committee is rather obscure. Estimates ranging up to 5 per cent. were proposed but evidently could not be supported by statistical data.

Increasing Cost.

This subject was subdivided so as to include (*a*) such increase as might be attributable to the age of the act in each state, and (*b*) abnormal industrial activity. The following factors were adopted:

(*a*)

Policy Year under Compensation Act.	Factors of Increasing Cost. (1)	(2)
1	1.00	.95
2	1.10	1.05
3	1.15	1.10
4	1.18	1.125
5	1.20	1.14

The difference between the two sets of factors is explained by the fact that the experience available to the committee was in varying stages of development. Column 2 contains the values applicable to the present experience data.

(*b*)

The allowance made for industrial activity has been fixed by the committee at 15 per cent. Satisfactory statistics upon which to base this factor were not available and the conclusion reached must be acknowledged as conjectural. Both factors reflecting increasing cost are combined additively and appear as a single factor in the final multiplier.

Occupational Disease.

The work of Mr. James D. Maddrill on this subject is already known to the Society. There has been no important new development since his valuable paper (*Proceedings,* Vol. II, p. 208) was presented and the committee has been guided chiefly by the results of his work, as follows:

For states where occupational disease is a cost element, a general differential of 1 per cent. is provided on all classifications. In addition a further differential is to be applied to selected classifications which present special occupational disease hazards, the sum of such extras to aggregate a further 1 per cent. of the pure premiums.

Effect of Schedule Rating.

The compensation rating schedule which is in general use has thus far resulted in a net decrease in premium volume. To offset the effect of this depression a correction factor has been provided applicable to those classifications which are subject to rating by schedule. For this purpose the conference adopted a loading of 9 per cent. In order to avoid the confusion of creating two sets of rates—one for classifications subject to schedule rating and one for those not so subject—it was decided to apply the correction to the pure premiums for the appropriate classifications.

Experience Rating.

A factor has also been introduced to correct the effect of experience rating which involves all classifications. Experience rating is limited to the larger risks and the net result of its application

is estimated at 1 per cent. of the entire premium volume. Theoretically the charge should be applied only to those risks which are subject to experience rating. In practice, however, it would be extremely cumbersome to do this. It is ingeniously argued that no unfairness results from this practical solution of the difficulty on the ground that experience-rated risks develop a net credit and hence are of a quality better than the average. Therefore, it is held reasonable to assume that the remaining risks are worse than average and as a group probably should be subject to a net debit. Like many other contentions encountered in rate-making, this one is not susceptible of tangible proof. The point is at present of little practical importance, however, and no harm can now result by conceding its possible validity.

Loading for Expense.

The 1915 rate conference determined upon 40 per cent. as the average loading properly chargeable under prevailing conditions to cover expenses. At that time the principle was introduced of modifying the average loading in order to reflect the variation in rate level as between the several states. Thus the loading for New York, where the scale of benefits, and hence the level of rates, are highest, was placed at 35 per cent., while for Pennsylvania—a state providing extremely small benefits, a loading of 42½ per cent. was adopted.

Following a plan similar to that adopted in 1915, the recent conference procured figures representing expenses incurred during 1916 by certain stock and mutual companies and arrived at the general conclusion that the indicated expense ratio had been 40 per cent. for the more highly organized stock companies and somewhat more than 18 per cent. for the mutuals. As the mutuals are largely dependent for dividend earnings upon lower expenses, the stock company figures have been customarily adopted in fixing the loading for both classes of companies. As in 1915, a difference in expense by states has been recognized and allowed for in the final multiplier.

While the principle of varying the loading percentage because of differing rate levels is now quite fully recognized in the calculation of rates for different states, the logical extension of that principle in its application to the particular scale of rates for a given state has not yet been adopted. One of the most important ques-

tions under discussion in the recent conference dealt with this very point and has suggested the paper by Mr. Joseph H. Woodward which appears in this number of the *Proceedings*. Owing to the pressure under which the rate revision was accomplished, there was little opportunity for a complete exposition of the subject. In connection, however, with the question of graduated law differentials, it was argued that the expense loading should vary in inverse ratio to the rate so that the resultant (if graduated differentials were used) would be a constant multiplier.

This was a convenient, if rough, assumption, but it failed to satisfy some of the members of the actuarial committee. A resolution was accordingly adopted calling for further study of the subject. Also, on an objection raised to the use of flat law differentials in projecting rates the actuarial committee reopened the matter and finally concluded that the graduated law differential and the graduated expense loading are correct in principle, that these two functions do not, when combined, produce a flat multiplier and as to the rates for New York (where the question had been raised) definitely recommended the adoption of the newly enunciated principles. The conference committee, however, was not so greatly impressed with the innovation and by a close vote rejected it—principally because it would have produced greater increases in the rates for the more highly rated classifications. Notwithstanding the action taken, the prominence given to this line of inquiry is an indication that on another such occasion there will be brought into the rate calculations a definite recognition of these two principles, viz:

1. That the law differential is not constant for all classifications but is a variable dependent upon the relative weight of each particular benefit contemplated by the pure premium.

2. That expenses should be assessed with reference to the magnitude of the rate with, possibly (as suggested by Mr. Woodward), the addition of a constant in the form of a policy fee.

For a clearer understanding of the problem which has given rise to these two questions, it should perhaps be stated that the first involves both the reduction of experience data to a common basis and the subsequent treatment of the basic pure premiums in the calculation of rates. The second is a logical refinement of the method heretofore followed in roughly assessing expenses as a flat percentage of the premium charged. The rapid development of more scientific rate-making in compensation insurance makes a

thorough and early investigation of these two questions exceedingly desirable.

The final conclusions of the committee with reference to expense loadings are expressed in the following table which, for convenience, includes a statement of the treatment adopted by the conference of 1915:

EXPENSE LOADINGS.

	1915.	1917.
Average expense loading (all states) expressed as percentage of gross rates	40%	40%
Allocated in the following manner:		
States with law differentials of less than 1.25	42½	42½
States with law differentials from 1.25 to 1.49	40	40
States with law differentials from 1.50 to 1.74	37½	37½
States with law differentials of 1.75 and over	35	36

The foregoing figures include no allowance for profit or for special expense incurred for the maintenance (as in Maryland and New York) of a state industrial commission.

MAINTENANCE OF STATE COMMISSIONS.

In addition to the usual premium taxes and license fees certain states impose upon insurance carriers a special assessment to cover the expense of maintaining an administrative board which supervises claim settlements. In Maryland and New York the assessment is based upon the amount of compensation paid during the year. In Kentucky there is a specific tax of 4 per cent. upon compensation premiums. Loading factors have been provided for New York (1½ per cent.) and Kentucky (2 per cent). The estimate of expenses for Maryland was not available when the conference adjourned.

PROFIT.

The principle that a margin for profit should be provided in the rates for stock companies was given recognition by the 1915 conference. At that time, however, no provision therefor was included in the rates. The stock company representatives this year reported in favor of a loading of 1½ per cent. which was taken to be the equivalent of 5 per cent. earnings upon such part of invested insurance capital as is subject to the risks of workmen's compensation insurance. Potential profits from favorable underwriting and from invested assets have not, apparently, been considered in connection with this subject.

Catastrophe Hazard.

The recommendations of the 1915 conference in this respect have been confirmed and an addition of 1c per $100 payroll has been provided for states other than New York, where it is fixed at 2c. This charge is imposed as a constant on the gross rate for all classifications. In the absence of reinsurance facilities the sums available from this source to many companies would fail of its purpose although in the aggregate it is probably sufficient. The cost of catastrophe reinsurance and the loading fixed for the hazard are wholly unrelated quantities. Small companies must have such reinsurance but cannot expect to be reimbursed out of their premium income for its cost. Companies having ample resources and a large volume of business can get along without it. The hazard, while remote, is real and must be allowed for. At the same time, competitive conditions do not admit of the assessment of a catastrophe loading in proportion to its value for the individual company. The provision made by the conference must be regarded as the recognition of a principle rather than as a rational basis for assessing the cost.

Final Multiplier.

The combined effect of all factors which operate upon the basic pure premium to produce the manual rate is expressed in a multiplier of the general form:

$$p(1+e_1)(1+e_2)(1+e_2)\cdots(1+e_n)+K=P,$$

where:

p = pure premium per $100 payroll,
P = gross premium,
e_1, e_2, etc. = various percentages of the pure premium,
K = a constant, already loaded for expense.

For illustration the values for New York are substituted in the formula as follows:

$$p(1.89\times 1.275\times 1.02\times 1.01\times 1.64)+.02=P,$$

where

1.89 = law differential,
1.275 = increasing cost factor,
1.02 = allowance for underestimates,
1.01 = allowance for experience rating,
.02 = catastrophe loading.

The factor 1.64 is obtained by combining (*a*) the expense loading (36 per cent.), (*b*) the special charge for expense of maintaining the State Industrial Commission (1½ per cent.) and (*c*) the profit loading (1½ per cent.)—all of which are assumed to be incurred as a percentage of the gross rate—in the following manner:

Expense—regular	.36 of gross rate
Expense—special	.015 of gross rate
Profit	.015 of gross rate
Total	.39 of gross rate

And,

$$\frac{1}{1-.39} = 1.64 \text{ (in terms of the pure premium).}$$

As before explained, the loading for schedule rating enters into the rate as a modification of the pure premium. The final multiplier for New York upon the foregoing basis is 4.07, the catastrophe constant of $.02 being added after multiplication.

Application of Tests.

In accordance with the plans of the conference, the basic pure premiums determined from the combined experience have been applied to the aggregate payroll exposure and to that of individual states. The data have been arranged in groups corresponding to certain basic pure premium magnitudes and the projected losses (obtained by applying the basic pure premiums against the payrolls) have been compared with the actual losses for each group and for the total experience. According to the records of the conference, four separate tests were applied:

1. A comparison to determine the average change produced by the adoption of new basic pure premiums. The combined payrolls of the several states were multiplied by both the old and the new premiums for each classification. The resulting projected losses indicated a net variation of about ½ of 1 per cent.

2. A comparison of actual with projected losses, using the combined data. Payrolls were multiplied by the new basic pure premiums and the results compared with the actual "reduced" losses. The projected losses so computed were found to exceed the actual by a little over 8 per cent. As the rates based upon the combined data are, in practice, applied by states, this test is not particularly useful.

3. A comparison to determine to what extent the newly selected pure premiums reproduce the actual losses developed under Massachusetts Schedule Z (Part I thereof—Act of 1912). As will be seen from the subjoined tabulation, the ratio of actual to projected losses for the entire data is practically 100 per cent. The departure is very slight excepting in the first pure premium group:

MASSACHUSETTS—PART I.

Act of 1912.

Group No.	Basic Pure Premiums.	Payroll.	Ratio of Actual to Projected Losses.
1	.03 to .10	$ 203,543,866	.732
2	.11 " .20	231,579,391	.964
3	.21 " .34	263,914,963	.989
4	.35 " .47	154,646,275	1.004
5	.49 " .67	87,544,722	1.006
6	.71 " 1.23	70,149,529	1.035
7	1.29 " 1.78	16,721,762	.997
8	1.86 " 7.42	31,774,296	1.025
	Total	$1,059,874,804	1.008

4. A comparison based upon the experience of individual states. These tests, as made by the conference, were limited to Massachusetts and New York data.

(*a*) MASSACHUSETTS EXPERIENCE.

This test was made in order to obtain an indication of the differential actually experienced under the amended Massachusetts Act of 1914. The principal results follow:

MASSACHUSETTS—PART II.*

Act of 1914.

Group No.	Basic Pure Premiums.	Payroll.	Ratio of Actual to Projected Losses.
1	.03 to .10	$ 70,528,065	.924
2	.11 " .20	63,778,827	1.412
3	.21 " .34	65,254,028	1.362
4	.35 " .47	53,937,436	1.317
5	.49 " .67	27,702,644	1.643
6	.71 " 1.23	22,715,023	1.422
7	1.29 " 1.78	6,512,776	1.125
8	1.86 " 7.42	7,834,545	1.440
	Total	$318,263,344	1.388

(*b*) New York Experience.

The purpose of this test was to determine the differential actually experienced under the New York law (Schedule Z—Policy Year, 1914).

New York—Original Act.*

Group No.	Basic Pure Premiums.	Payroll.	Ratio of Actual to Projected Losses.
1.....	.03 to .10	$ 423,227,053	.915
2.....	.11 " .20	154,468,057	1.418
3.....	.21 " .34	109,283,555	1.368
4.....	.35 " .47	134,346,408	1.451
5.....	.49 " .67	96,859,375	1.583
6.....	.71 " 1.23	75,206,623	1.645
7.....	1.29 " 1.78	13,738,789	1.476
8.....	1.86 " 7.42	26,797,420	1.828
	Total.....	$1,033,927,330	1.533

Particular attention was focused on the New York test by reason of the discussion over the question of graduated differentials. The New York Insurance Department made further tests to discover how the new basic pure premiums would affect the New York rates at various rate levels.

The first of these, using the same grouping as above, indicated for several groups a decided departure from the average differential. The comparison was made by taking the indicated experience differential of 1.533 and multiplying it into the projected losses derived from the basic pure premiums. The results were then measured against the actual New York losses, as shown below:

Group.	Basic Pure Premium.	Actual Losses.	†Projected Losses.	Discrepancy Per Cent.
1.....	.03 to .10	$ 211,518.00	$ 354,249.00	67.5
2.....	.11 " .20	349,974.00	378,410.00	8.1
3.....	.21 " .34	390,676.00	437,760.00	12.1
4.....	.35 " .47	802,308.00	847,378.00	5.6
5.....	.49 " .67	893,609.00	865,228.00	— 3.1
6.....	.71 " 1.23	1,071,207.00	998,133.00	— 6.8
7.....	1.29 " 1.78	291,645.00	302,987.00	3.8
8.....	1.86 " 7.42	1,069,466.00	897,018.00	—16.1
	Total.....	$5,080,403.00	$5,081,163.00	

* The foregoing tests were made before the conference had completed its determination of premiums, a fact which accounts for the discrepancy in the aggregate figures.

† Projected losses on Massachusetts basis × 1.533.

It will be noticed that the method of grouping adopted by the conference follows no particular scheme, the data merely being subdivided into eight parts. A regrouping was subsequently made by the New York Insurance Department, the effort being to produce groups having approximately the same volume of actual losses. The lowest pure premium group (under .05) has been omitted:

No.	Group.	(1) Payroll.	(2) Actual Losses.	(3) Projected Losses.	(4) Experience Differential (2)÷(3).
1....	.05 to .21	$423,165,678	$ 665,889	$ 493,398	1.350
2....	.23 " .41	140,671,789	617,263	454,394	1.358
3....	.43 " .51	88,808,192	603,565	410,861	1.469
4....	.54 " .64	70,147,883	668,134	419,026	1.594
5....	.67 " .81	45,129,693	546,692	331,033	1.651
6....	.85 " 1.29	39,964,803	651,685	404,775	1.610
7....	1.35 " 1.95	18,703,110	555,568	311,994	1.781
8....	2.04 " 7.09	18,855,649	753,738	432,378	1.743
	Total.....	$845,046,797	$5,062,534	$3,257,859	1.554

The trend shown in column (4) above is significant as well as interesting. The lower rate groups develop low differentials, which increase with the pure premium. These results have been graduated by a graphic method and yield a remarkably smooth and consistent curve.

The argument against the use of graduated differentials derived in the foregoing manner hinges upon the fact that all rates of the same magnitude do not necessarily contemplate the same *quality* of loss, and hence may require varying differentials.

As an example let us assume two classifications, "*A*" and "*B*," for which the basic pure premium is $1.00. Also let us assume the following rough subdivisions:

PURE PREMIUM FOR BASIC STATE.

Type of Benefit.	Classification "*A*."	Classification "*B*."	Actual Law Differential.
Death.....	$ .10	$ .40	2.50
Permanent partial disability.....	.20	.30	2.00
Temporary disability.....	.30	.20	1.50
Medical.....	.40	.10	1.20
Total pure premiums.....	$1.00	$1.00	

The corresponding pure premiums for the secondary state would then be as follows:

PURE PREMIUM FOR SECONDARY STATE.

Type of Benefit.	Classification "A."	Classification "B."
Death	$ .10 × 2.50 = .25	$ .40 × 2.50 = 1.00
Permanent partial disability.	.20 × 2.00 = .40	.30 × 2.00 = .60
Temporary disability	.30 × 1.50 = .45	.20 × 1.50 = .30
Medical	.40 × 1.20 = .48	.10 × 1.20 = .12
Totals	$1.58	$2.02

Thus, for Classification "*A*" the correct differential is 1.58 and for "*B*" it is 2.02, notwithstanding that both classifications take the same *basic* pure premium.

Using either average differentials or those produced by a graduation based upon rate magnitude, premiums for the secondary state bear a constant relation to corresponding basic pure premiums having the same arithmetical value. That is, all classifications having a basic pure premium of $1.00 take the secondary pure premium $(1+k)\times\$1.00$ where k equals either the general constant differential applicable to all classifications or the specific constant applicable to the basic pure premium of $1.00. Using sectional differentials, the factor $(1+k)$ is subdivided into as many of its component elements as may be found convenient, in accordance with the foregoing illustration.

The various tests which have been applied to the selected pure premiums are of value chiefly in that they indicate whether, in the aggregate, allowance has been made for future losses at least equal to those actually entering into the experience. What the conference contemplated, as shown by its records, was something more, viz: that detailed adjustments based upon the test indications should be applied to the pure premiums of each state. By such means it was expected that the effect of using constant law differentials and expense factors would, in large measure, be rectified. In this respect, however, the conference failed to carry out its plan, for such adjustments have not been made.

The actuarial committee has, in connection with this subject, a field for valuable work. Experience data from additional states will soon be available. Its value should not be impaired for want of a suitable and rational method of utilizing it in combination with other data.

SUMMARY AND CONCLUSION.

Based largely upon actuarial and statistical analysis and advice, the conference has brought about a general increase in rates which

is expected to yield sufficient additional income to meet changed conditions.

Readjustments have been made of the rates for particular classifications. Many of these readjustments are necessarily of a temporary character not only because of the absence of satisfactory experience statistics, but also because of changes which in the near future promise to arise in connection with the employment of such data in rate-making. Provision has also been made for special treatment in the rating of certain classifications which present unusual features such as chemical works (where under existing conditions the hazard of high explosives is likely to be encountered), subway, canal and other large construction contracts.

There have been brought into prominence new viewpoints with reference to methods of utilizing experience data in the determination of rates. In particular should be mentioned those involving the use of graduated law differentials and expense loadings in lieu of the present practice of applying single or constant multipliers. It is somewhat unfortunate that greater consideration could not, in the limited time available, have been given to this important subject. It is extremely probable, however, that in the next general rate revision it will not be brushed aside. The burden of premium cost should be equitably distributed in proportion to the risk value of each classification. That some classifications are bearing more than their equitable share while others are unduly favored is inherent in the prevailing methods of rate calculation.

A feature of the recent conference that should be mentioned is the co-operation which has resulted from the conjunction of elements having widely differing business interests and points of view. New developments in rate-making theory must eventually find expression in future rates which, in all probability, will be determined by some form of general co-operative effort. It would seem opportune, as well as desirable, if steps could be taken to place the entire problem of compensation rate-making in the hands of a permanent and fully representative body. There appears to be no good reason why fundamental principles should not be considered solely upon their merits, completely divorced from competitive considerations. A permanent organization, properly constituted, would be able to work out the solution of many difficult questions which are common to all classes of companies.

Rate Regulation.

BY

ALBERT W. WHITNEY.

That there must be some sort of regulation of competition in insurance, either by organization among the carriers or by the state, is too well established now to need demonstration. The more pertinent question at this stage of our development is: what shall be the nature of this regulation?

The object to be secured is obvious: right rates. A "right rate" implies that the hazard of a risk can be correctly determined; but this determination would be an extremely difficult one to make even were no elements involved other than a pure scientific desire for correctness. When however the problem is complicated by the desire for profit and by the presence of competition, the difficulties become much greater.

The rates, as a whole, may be in error, either by being too high or by being too low. The natural result of unrestrained competition is the use of rates that are too low; this could hardly be so were it not for the fundamental difficulty of knowing exactly what the rate ought to be, for no one with full knowledge of the facts would use rates that were insufficient. But competition, acting in the presence not only of uncertainty as to the proper rate for the class but uncertainty with regard to the degree of hazard in the individual risk, has the inevitable tendency to drive the rates too low.

Where competition is restrained there is in theory the possibility of rates being too high. In practice this is a remote contingency; as too high rates must almost inevitably produce a condition which leads to their readjustment. This is particularly so in the case of workmen's compensation insurance, owing to its quasi-public character. The early history of rates in New Jersey and Massachusetts bears this out. The most important problem of rate regulation in the case of workmen's compensation is therefore the securing of adequacy.

The acknowledged necessity for regulation of some kind, taken in

conjunction with the acknowledged duty of the state to safeguard the solvency of the companies in the interests of the public, indicates the necessity for some form of state control.

The first state to pass a law regarding the regulation of compensation rates was Massachusetts. This law provided for approval as to adequacy; it was copied substantially in New York and other states. More recently a number of states have enacted laws providing for the approval of reasonableness as well.

In the effort to determine what constitutes a proper form of state regulation, we may with advantage analyze the similar procedure in the case of life insurance, recognized to be the most thoroughly developed form of insurance.

The only control of the general level of rates in the case of life insurance is through the reserves. This is in practice an effective control. The reserves are prescribed by the laws of the various states which specify the table of mortality and the rate of interest to be used in their calculation. Control through reserves is effective in securing a scale of minimum adequate rates; there is no control of the reasonableness of life insurance rates; this is left to competition.

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.

If the analogy with life insurance is to be followed out, we should admit the propriety of a control of minimum adequate rates by the state, while the question of reasonableness is left to be controlled through competition.

An "adequate" rate law may be interpreted in two ways. The approval may be based strictly on adequacy or on minimum adequacy. The Massachusetts law when first applied was interpreted in the former sense. A company filed its rates; if they were deemed to be adequate they were approved without raising the question of whether possibly they might be more than adequate. But with the growing consciousness of the rating problem as a single problem with its objective "right rates," and in line with the practice of the stock companies of filing one set of rates for all, the adequate rate law has come to be interpreted in all states as calling for the approval

of minimum adequate rates. That is to say, in practice, the approval that the state official is called upon to make is the approval of one standardized set of rates and this is understood to be the minimum scale of rates that he deems to be adequate and that will therefore meet with his approval.

Any rates approved by the state as minimum adequate rates competition will cause to be the going rates, provided they are not so low as to be absolutely unreasonable; this has been demonstrated by experience.

It appears therefore that a control of the adequacy of rates is also in actual practice a control of their "reasonableness" as well both in theory and in actual practice.

Since therefore specific control of reasonableness is unnecessary, the preferable procedure is control of adequacy alone. It is simpler, and there is not the same temptation to abuse that there is in the case of a specific control of reasonableness. There is the danger, and experience shows it to be a real one, that political pressure will cause rates to be fixed by officials at too low a level, and this is particularly true if specific control of reasonableness is provided.

It is not an imaginary situation in the case of a rate revision to find all the reductions approved by a state official and all the increases disapproved. It is obvious that such action as this by an official can not be the basis for any fundamentally sincere treatment of the rating problem. The inequity as between states is apparent. No fault is to be found with the principle of state control; that is as it should be, but the danger of its possible abuse should be reduced as much as possible.

In this connection, an observation should be made; namely, that a law providing for approval of rates indicates that the initiative is to lie with the insurance carriers themselves. This is a very different thing from state rate making.

This consideration brings me to the real thesis of this paper, namely, that the hope for a well-balanced rating system, free from arbitrary action by any particular state, lies in the establishment of a standardized rating procedure of sufficiently great repute to command universal respect.

Here again we may observe the situation in life insurance. In life insurance there is complete control of minimum adequate rates on the part of each individual state, and yet there is not arbitrary action. Why? Because a standardized rate-making procedure has

been built up of so great repute that no state would undertake to set it aside. When it becomes advisable to devise a new mortality table, no state takes arbitrary action, but the procedure is most careful and well-considered, a matter for the Convention of Insurance Commissioners and the companies, through the actuarial societies, to consider together.

A similar procedure should be our goal in the compensation field. Already wonders have been accomplished in the short space of time since the inception of compensation in this country. The getting together, in the so-called Conference of 1915, and the so-called augmented Standing Committee of 1917, of all the various forces directly interested in compensation rates, stock companies, mutuals, state funds, insurance departments and industrial commissions, was most significant. This good work must go on; it is a work on which all should unite. This Society, through its papers and discussions and committees, has already been a potent force. The time should not be far distant when the standardization of rates shall have been as fully accomplished in the compensation field as in the field of life insurance.

THE THEORY OF LAW DIFFERENTIALS.

BY

G. F. MICHELBACHER.

I have prepared this paper not with the idea that the information it contains is original, or the result of individual research on my part, but rather with the thought that some record should be made in the transactions of this Society of the interesting developments in the theory of law differentials which have grown out of the recent revision of the Workmen's Compensation Manual. In addition, it is hoped that this presentation may gain for the subject a wider range of discussion than is possible in committee work.

There can be no question concerning the proposition that the actuarial theory of law differentials is in the process of formation; it will bear much additional investigation and study. While its complete development probably cannot come until our workmen's compensation experience is available in much greater volume, the theory has certain interesting theoretical possibilities which can be profitably considered at this time. In what follows I have attempted to outline the subject in brief and to point out some of the more important differential methods which were proposed during the proceedings of the Actuarial Sub-Committee of the Augmented Standing Committee on Workmen's Compensation Rates.*

THE RELATIONSHIP OF THE LAW DIFFERENTIAL TO THE BASIC MANUAL.

In workmen's compensation rate making the conception of the law differential has facilitated the establishment of the principle of the so-called "Basic Manual." This principle in brief is founded upon the hypothesis that notwithstanding the widely different

* This committee was responsible for the actuarial work of the revised Manual of Workmen's Compensation Rates. Its members were Messrs. Black, Cogswell, Flynn, Michelbacher, G. D. Moore, Mowbray, Scattergood and Woodward—all Fellows of this Society. Mr. Cogswell acted as chairman, Mr. Michelbacher as secretary.

benefit provisions and claim administrative procedure of state compensation acts, there is a fundamental definition of basic hazard for each manual classification which does not vary with territorial divisions of the country; in other words, that the collective hazard of each manual classification remains the same throughout the country, provided such factors as claim cost and administration, accident frequency, industrial activity, etc., are constant. Thus fundamental hazard relationships which do not vary with territorial divisions of the country may be established as follows:

An iron foundry represents twice the hazard of a cotton spinning and weaving establishment.

A steel foundry represents twice the hazard of an iron foundry.

General trucking represents a hazard equivalent to the hazard of a steel foundry.

Structural steel erection represents four times the hazard of general trucking.

This general law is subject to exceptions, of course, wherever the conditions under which an industry is carried on in a particular territory differ radically from the conditions under which the industry is carried on in the remaining parts of the country. The clearest instances of this character are found in connection with mining operations of various sorts and in logging and lumbering and contracting operations. However, the problem of determining which classifications shall be treated as exceptions because of local conditions and what the deviation from the basic hazard valuation for these classifications shall be, is a specific problem which is of minor importance when compared with the more general problem of determining the index of hazard for each classification in the Basic Manual.

The fundamental index of hazard may be defined as a measure of the capacity of risks in each classification to produce accidents. A premium rate, however, should not only measure the capacity of a risk to produce accidents of certain types with a certain frequency; it should also measure the cost of compensating the injured workmen who sustain these accidents. The fundamental index of hazard, inasmuch as it covers only a part of the ground, must, therefore, be supplemented by a measure of the cost of compensation. This combination of the frequency of accidents and the cost of compensation is what is known as a basic pure premium. In practice the basic pure premium represents a measure of the

capacity of risks in the individual classification to produce accidents, upon the assumption that these accidents when produced will be compensated for under the benefit provisions of a definite compensation act. This act is the basic compensation act. It may be an act under which compensation claim settlements are being made at present, it may be one that has been discontinued, or it may be a hypothetical act that has never been applied to compensation claim settlements in any state. When the theory of the basic manual was introduced, the workmen's compensation act under which the greatest amount of statistical experience had been accumulated was the original Massachusetts Act. This was, therefore, taken as the basic compensation act. The greatest volume of state experience is no longer found under the original Massachusetts Act. Nevertheless, it has been continued as the basic act principally because the rating procedure has become more or less firmly established; also because it is now permanent, in that it has been discontinued and is, therefore, no longer subject to amendment.

The function of the law differential is to measure the relative cost of the benefits of a state workmen's compensation act as compared with the cost of the benefits of the basic act. Each state act has a law differential that is subject to amendment whenever its benefit provisions are amended. Thus, the California law differential now used indicates that the benefit provisions of the Workmen's Compensation Insurance and Safety Act as amended August 7, 1915, are on the average 66 per cent. more costly than the benefit provisions of the original Massachusetts Act. The California pure premium for a classification which is not treated individually because of peculiar local conditions may, therefore, be obtained by multiplying the basic pure premium for the classification by 1.66.

The use of the law differential is not limited to the projection of basic pure premiums, however. It has a second important function; namely, its use may be reversed and in this way losses incurred under the provisions of the California Act or any other act may be reduced to the basis of the provisions of the original Massachusetts Act which represents the basic pure premium level. By means of this reverse operation the greatest volume of compensation experience can be made available for rate making purposes, thereby rendering possible the establishment of basic pure premiums with proper consideration for the law of averages.

The law differential then, is essential to and permits the application of the principle of a basic manual of workmen's compensation insurance rates. Just how vital this principle is to efficiency in rate making may be estimated by a consideration of the improved rating conditions under compensation insurance as compared with corresponding conditions under employer's liability insurance, where a separate manual was used for each state and where rates were based upon individual state experience.

The basic manual promotes uniformity of statistical and underwriting procedure inasmuch as one set of classifications and rules is applicable to all compensation states. Furthermore, the basic manual makes it possible to treat the rate making problem as a national problem. The importance of this cannot be overestimated, for national treatment of the rating problem means, among other things, the employment of the best talent for rate making, the elimination of local influences created by competitive controversies, the maintenance of consistent rates in all states, the establishment of rates upon a broad and dependable statistical basis and the possibility of securing a birds-eye view of the entire rate situation from the standpoint of adequacy. In short, centralization makes for a more intensive study of the rating problem in all its phases. Without question, if compensation rate making continues to be considered as a national problem, it will be possible to evolve a theory of rating which will have the universal recognition now accorded life insurance actuarial science. These facts explain the importance which has been attached to the theory of law differentials.

Differentiation Between the Use of the Law Differential as a Reduction Factor and as a Projection Factor.

As pointed out above, the law differential may be used in two ways. It may be used to reduce past classification experience to the basic pure premium level, or it may be used as one of the factors of a multiplier to project basic pure premiums into the future as state rates. In order that there may be no confusion, it should be stated at this time that the value of the law differential need not necessarily be the same in these two operations. It is the function of the law differential to measure the cost of compensation under a certain compensation act. This definition implies a measurement not only of the compensation provisions of the act but also of the

administrative provisions, and what is still more important, of the interpretation of the benefit provisions by the administrative claim body. Undoubtedly, both interpretation and general administration of compensation acts are changing. Compensation claim procedure is still in the process of formation. Thus it may be that many more permanent partial disability cases will be recognized when the interpretation of compensation acts has reached its ultimate stage of development and that the method of compensating cases of permanent partial disability will radically change.

Because cost conditions are changing, the value of the law differential is subject to change also. The value used in the reduction of experience should represent past cost conditions; that is to say, cost conditions which obtained during the policy period covered by the experience. The value used in the projection of pure premiums should represent conditions which will be assumed to obtain during the policy period for which the rates are contemplated. For the past, definite information concerning cost conditions may be available. If so, all such available information, if dependable, should be used in the computation of the reduction differential or differentials. For the future, which usually is limited to two calendar years, cost conditions must be assumed. The assumption to be made in this connection will necessarily be a matter for judgment. It is the writer's judgment that the only sound basis for prognosticating future cost conditions is the assumption that such cost conditions will approximate the ultimate development of all factors which have bearing on determination of the rate—the ultimate distribution of accidents by kind of injury, the most liberal interpretation of compensation benefits, etc.

Methods of Differential Calculation.

If the nature of the data upon which the calculation is made is taken as a basis, there are two general methods of differential calculation that are recognized at the present time.

The first of these methods may be termed "the injury distribution method." The basis for calculation here is one or several distributions of accident cases by ultimate nature of injury. The accident distribution that has been used to date in connection with this method of differential calculation is the Rubinow Standard Table. This table presents the ultimate results from an injury standpoint of 100,000 accidents. The table is an average table in

that it is intended to apply to all industries rather than to one specific industry or group of industries. The 100,000 accidents, which serve as the basis for the distribution, are first analyzed by broad groups of injuries. Thus, the table gives the number of accidents which ultimately result in death, the number which ultimately result in permanent total disability, the number which ultimately result in permanent partial disability, etc. These injury groups are then sub-divided. The temporary disability group, for example, is further analyzed to show the number of cases which result in disability lasting less than one week, the number of cases which result in disability lasting from one to two weeks, etc. The fatal accident group is further analyzed to show the number of deaths involving no dependency, the number involving total dependency, etc. Theoretically, upon any assumption of general accident frequency, the table will give answers to such questions as the following:

What is the probability of temporary injury to a full time yearly worker?

What is the probability of injury to a full time yearly worker involving temporary disability lasting from one week to two weeks?

What is the probability of death to a full time yearly worker?

What is the probability of death to a full time yearly worker who has no dependents?

The law differential computed on the basis of a distribution of this character in reality has the form of a mathematical expectation. The amount at stake in the event of any particular injury is the compensation payment which is necessary under the provisions of any law to indemnify a workman sustaining such injury. The probability of the occurrence of the injury can be taken from the table. Thus, it is possible to compute individual expectations for every kind of injury. The final differential is the sum of many expectations which cover the range of possible accident cases from an injury standpoint.

The second method of differential calculation may be termed "the experience method." The basis for calculation here is matured compensation experience. To be of the greatest value such experience should be classification experience, that is to say, it should be available for individual manual classifications. Inasmuch as the law differential is a comparative figure, experience must be available under two compensation acts for the computation

of any differential; an experience on the one hand under the compensation act which is taken as the basic act and an experience on the other hand under the act for which a differential is to be computed. As this method of calculation is based upon matured experience accumulated during the past, it is fairly applicable to past cost conditions. The method becomes slightly involved, however, when applied to the future. This is true whether it is applied to the same compensation act for which experience is available or to an amended act. The use of the method involves a careful investigation of the dependability of the experience, the cost conditions contemplated by the experience and other factors which in any way affect claim cost. These problems will be considered later. It is well to point out at this time, however, that the use of actual classification experience will not cover all the phases of law differential calculation. Actual experience must be supplemented by some form of injury distribution, particularly in the computation of law differentials for the projection of state rates.

It should be noted also that this method does more than produce a law differential if by this term is meant a measure of the cost of one compensation act as compared with another. The use of actual classification experience brings into the calculation such factors as increasing cost due to the age of the act or to abnormal industrial activity, variations in accident frequency, underestimates of outstanding losses, etc. For this reason the term "law differential" is rather loosely used in this connection. Strictly speaking it is impossible to compute a law differential by the experience method.

Forms of Law Differentials.

Regardless of method of computation the relative cost of any compensation act may be represented by one differential or by several. The use of one differential is a very satisfactory method of comparing the relative cost of compensation acts for all industries. Under the injury distribution method of calculation the use of one differential assumes that the distribution of accidents by kind of injury is a composite of many injury distributions for individual industries or groups of industries. Where actual experience is used, one differential assumes that the average cost conditions represented by the total experience are applicable to individual industries. For this reason, wherever a compensation act places particular emphasis upon one or several kinds of injury, one differen-

tial may not be particularly well adapted to represent the cost of the act for individual industries. If the compensation for death is particularly liberal in one state as compared with another, the use of one differential to represent the cost of compensation for all industries in the two states in question does not produce results that are entirely consistent, from the standpoint of individual industries.

In recognition of the fact that one law differential does not always accurately measure claim cost for all industries within a state, it has been proposed to use more than one differential or a system of differentials to represent the cost of a compensation act. The form of a system of differentials varies. The differential may be a function of the basic rate; that is to say, it may vary with the value of the basic pure premium. It also may be a function of the industry; one differential may be established to represent the cost of a compensation act as applied to the accidents produced by the textile industry; another may represent the cost of the compensation act as applied to the accidents produced by contracting risks, etc. Finally, the law differential may be broken up into several differentials—one for each kind of benefit. Thus there may be one differential for the medical benefits of an act, another for the death benefits, a third for the temporary total disability benefits, etc.

Obviously, a complete description of the various forms of differentials cannot be attempted in a paper of this character. I shall, therefore, limit myself to a brief statement of the several forms which have just received consideration by the Actuarial Sub-Committee of the Augmented Standing Committee.

A System of Law Differentials by Kind of Benefit.

The application of this form of differential to the projection of basic pure premiums would necessitate the establishment of partial basic pure premiums, one basic pure premium for each element of the total loss cost. Thus, if the present pure premiums were built up of several pure premiums, one for each kind of benefit, a system of law differentials might very well be employed to translate the basic injury pure premiums into corresponding injury pure premiums for any particular compensation act. In this way a total state pure premium for each classification might be constructed by summing its component parts. At present, however, our statistical information for individual classifications is so limited in the majority of cases that it is impossible to refine the problem of basic pure premium determination to such an extent.

It has been pointed out that the use of one differential for all classifications assumes that an average injury distribution is applicable to individual classifications. A single differential as a reduction factor may not properly reduce experience for individual classifications which have injury distributions varying from the average, particularly when the act to which the differential applies disproportionately compensates a specific kind of injury. To take an extreme case let us assume that an average distribution of injuries provides for two deaths for each one hundred non-fatal accidents, and that the death benefits of a certain act are particularly high. The single law differential for this act will reflect these conditions. This law differential will be applicable without question to any classification for which the average distribution of deaths and non-fatal cases holds. It will be too high, however, for a classification for which the normal distribution is .5 death to one hundred non-fatal accidents, and too low for a classification for which the normal distribution is six deaths to one hundred non-fatal accidents. The use of a single law differential as a reduction factor would, therefore, distort the experience for certain classifications. Such method of reduction would arbitrarily produce a fictitious excess of modified losses for classifications with death ratios higher than the average and a fictitious deficiency of modified losses for classifications with death ratios lower than the average.

The danger from this source is practically negligible at this time because there are very few classifications for which a sufficient volume of experience is available to permit the establishment of a basic pure premium upon experience alone. Rate making is still dependent upon the use of underwriting and actuarial judgment. The available experience is, of course, an excellent guide and is being used more and more in moulding judgment, but the time has not yet come when experience can be substituted for judgment in the establishment of basic pure premiums for all classifications. This time is approaching, however, and is being brought nearer by the gradual accumulation of experience. The Augmented Standing Committee this year had available experience comprising a total payroll exposure for all classifications of approximately $4,500,000,000. This exposure represented three times the exposure covered by the experience which was available to the Committee last year. Next year this exposure may be doubled. It is, therefore, high time that consideration is given to the evolving of more accurate methods of experience reduction.

A system of law differentials by kind of benefit is not impracticable from the standpoint of experience reduction even though our present classification experience has not been fully developed and is not entirely complete.

It has been the custom in the past to provide for some analysis of compensation losses by kind of benefit. The classification of losses has not been standardized, nor has it been carried to the same degree of refinement in all experiences. It has been recognized, however, that some segregation of losses is essential and such analyses as have been available have greatly facilitated the establishment of basic pure premiums. An analysis of losses is particularly important at the present time when our compensation experience for the majority of classifications is incomplete, for even if crude an analysis makes it possible to detect abnormalities, and consequently, allows greater latitude in the use of experience. For instance, it has always been the custom to state separately death losses in classification experience. Thus, it can be ascertained at a glance whether the experience for an individual classification contains death losses at all or whether the death losses contained in the experience are greater or less than normal. In this way the actual experience pure premium has been increased in certain cases to provide for the absence of death losses, the basic pure premium being built up from incomplete experience upon the assumption that the pure premium indicated by the experience was truly representative of the loss cost of the classification for non-fatal accidents. In other cases, a part of the death losses has been eliminated and the remaining experience pure premium taken as the basic pure premium upon the assumption that the elimination of abnormal death losses produced a proper measure of the hazard of the classification.

A complete analysis of losses when available will permit greater refinement of this procedure and will eventually make possible the establishment of basic pure premiums with the least exercise of judgment. It is safe to assume, therefore, that our compensation losses will always be analyzed in this manner and that the analysis will some day become standard. Such being the case, the use of a system of law differentials by kind of injury as a method of reducing experience should receive careful consideration, inasmuch as it apparently presents a satisfactory solution of some of the difficulties which have been encountered in the use of a single differential as a reduction factor for all classifications.

The principal advantage of the use of a system of law differentials by kind of benefit in the reduction of experience arises from the fact that this method will properly reflect the actual conditions of the experience for the individual classifications, both as to the actual distribution of losses by kind of injury and as to the proper relative value of the experience on a reduced basis.

The method of procedure necessary to the use of a system of differentials of this character is as follows:

1. The losses of all state classification experience should be analyzed in accordance with some standard classification of benefits by kind of injury. For example, a standard classification of benefits might be as follows:

(*a*) Death.
(*b*) Permanent total disability.
(*c*) Permanent partial disability.
(*d*) Temporary disability.
(*e*) Medical in all cases.

2. A differential for each compensation act for each kind of benefit would then be computed. In the computation of these differentials either the experience method or the injury distribution method might be used.

3. In the reduction of state classification experience, the proper differential would be applied to each division of the losses. Thus, if there were no losses other than temporary disability and medical losses for a particular classification, the differentials for these two kinds of losses and no others would be used in the reduction of the experience; if all kinds of losses were represented all the factors would be used in the reduction of the experience, etc. The reduction factor in each case would represent the relative cost per case of death, permanent total disability, permanent partial disability, temporary disability or medical benefits. In this way the fact that losses might not be normal for the classification in question would be properly taken care of. The fact that the differentials represent the cost of the specific kind of injury rather than a composite cost for all kinds of injury would insure proper reflection of the actual distribution of losses in the reduced experience. Thus if death losses predominated in the actual experience, death losses would predominate also in the reduced experience. If there were no death losses in the actual experience, then there would be no death

losses in the reduced experience. Furthermore, once the losses were reduced and combined, the experience pure premium would be a proper indication of the reduced cost of the state experience. It would not be distorted except by such minor influences as the varying distribution of death cases by degree of dependency, the physical condition of employees in different classifications or in different industries, etc.

A System of Law Differentials by Homogeneous Groups of Industries.

This form of differential has advantages when used in the projection of basic pure premiums. It is not well adapted to the reduction of experience because the arguments against the use of an average differential for all industries may be applied to the use of an average differential for a single industry particularly if the classification experience is not complete. Thus, the use of a differential which includes provision for death accidents and their compensation, for the reduction of the losses of a classification which has no death losses because the experience is incomplete may be seriously criticised.

This criticism would not apply to the projection of pure premiums because even though the basic pure premium has been established upon insufficient experience, the judgment of the Committee establishing it has taken cognizance of all deficiencies in the experience, with the result that the basic pure premium, theoretically at least, provides for a complete distribution of loss cost.

The method of applying a system of differentials of this character in the projection of basic pure premiums would be to use the proper differential for the industry to project the basic pure premiums for all classifications falling within the industry. Thus one differential might be used to project the basic pure premium for Cotton Spinning and Weaving; another for Iron Foundries; a third for Masonry work; a fourth for Street Railway operation, etc.

A system of differentials of this character might be computed by either method of calculation. The injury distribution method of calculation would require for its application a distribution of accidents by ultimate nature of inquiry for each homogeneous group of classifications. The calculation of each of the differentials would then be exactly the same as the calculation of a single differential for all industries. Each differential would represent the applica-

tion of the benefit provisions of the act in question to the distribution of accidents for the industry or homogeneous group of industries.

The application of the experience method to the calculation of a system of differentials of this character would involve the following procedure:

1. All classifications in the Manual should be classified into broad groups. The basis for classification should be such that classifications involving substantially the same distribution of accidents would fall within the same group. The number of groups should be limited possibly to a maximum of ten. The actual classification experience would be of some assistance in determining which group a classification should fall in. Where the classification experience is incomplete or abnormal, judgment should be used by the actuary and the classification assigned upon the basis of such judgment supplemented by advice from underwriters and safety engineers. This set of groups would be assumed to be standard inasmuch as it would be used generally for all states in the calculation of differentials. For the proper application of the method, it is essential that the groups be broad enough to produce dependable pure premiums, that is to say, the pure premium for each group should be based upon a sufficient spread of exposure to be reliable.

2. For the calculation of any differential, experience would be necessary for the homogeneous group, both under the basic compensation act and the act for which a differential is to be computed. The experience differential for each group should be obtained by comparing the pure premiums for the group for the basic act and for the act for which the differential is desired. There would be as many experience differentials as there were groups.

A System of Law Differentials by Rate Groups.

This form of differential is closely analogous to the system of differentials by homogeneous groups of classifications; in fact the method which is outlined below may be applied either to rate groups or to homogeneous groups of classifications. Like the latter form of differential, it is not particularly well adapted to reduction under present conditions. It, however, presents some interesting considerations as a projection factor.

The only method available for the computation of this form is

the experience method. The first approximation to the experience differential for all classifications may be obtained by a comparison of the combined pure premium for the state experience for which a differential is desired with the corresponding pure premium for the experience under the basic act. This approximation is necessarily rough because it does not take into consideration the relative distribution of the business in the two experiences. Inasmuch as the pure premium measures loss cost it fluctuates with the hazard. Thus, an experience which covers light manufacturing industries will indicate a lower pure premium than an experience which covers mining and quarrying industries. Any method of differential calculation based upon actual experience must recognize this condition and meet it in some way or other. The system of differentials by homogeneous groups of classifications described above meets this condition in some measure by grouping classifications in such manner that those of the same hazard with substantially the same distribution of injuries are thrown together for the purpose of differential calculation. This procedure does, however, neglect the actual payroll distribution within the groups.

The system of law differentials by rate groups as considered by the Actuarial Sub-Committee of the Augmented Standing Committee provides an exceptionally good method of avoiding this difficulty. This method was proposed by Mr. Albert H. Mowbray.

The basic pure premium represents the average distribution of accidents for the classification plus the benefit cost conditions of the basic act. Theoretically if a large enough experience were available under the basic act, the basic pure premiums could be established upon such experience alone. Some experience is available for the basic act. Consequently, it is a comparatively simple matter to project the basic pure premiums into the payrolls of such experience and then to compare the losses produced in this manner with the actual losses. Because of the definition of the basic pure premium, the correspondence between the projected losses and the actual losses should be very close, if the total volume of payroll for the basic act is broad enough to be dependable. The experience under the present basic act is known as Massachusetts Schedule Z—Part I. Test shows that the basic pure premiums adopted by the Augmented Standing Committee this year when projected into the payrolls of Massachusetts Schedule Z—Part I, reproduce the actual losses with the remarkably narrow margin of 8/10ths of 1

per cent. It may, therefore, be assumed that the basic pure premiums are on the average accurate measures of compensation cost under the original Massachusetts Act. It follows, that if these pure premiums are projected into the payrolls of any state classification experience, the result will represent losses which would have been incurred upon the assumption that these payrolls were exposed to payments under the terms of the basic act. If these projected losses are then compared with the actual losses for the same experience a measure is obtained of the relative cost of the act under which the experience was accumulated. The effect of varying distribution of business is automatically eliminated, for both projected losses and actual losses are referable to the same payroll exposure.

The actual method of computing a system of law differentials for New York would be as follows:

(*a*) Classification experience is available for New York in the form of Schedule Z, which the New York Insurance Department requires all compensation carriers to file with it.

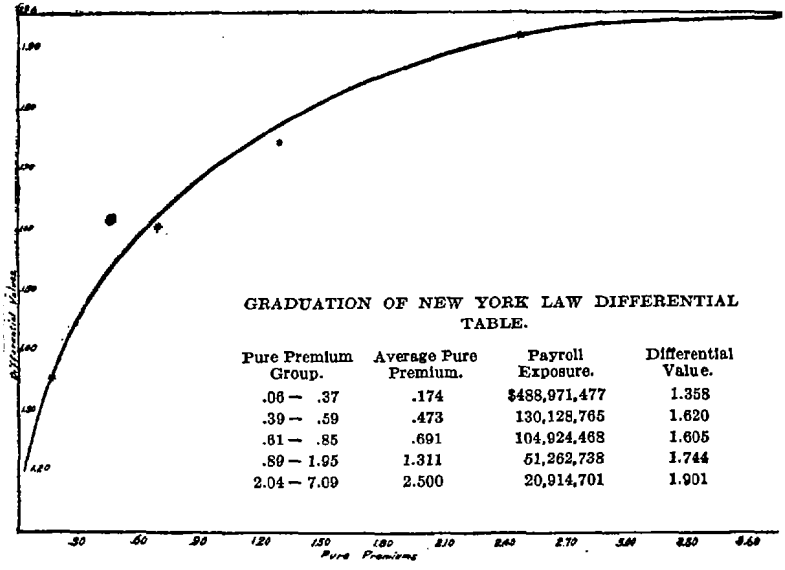
(*b*) The elements necessary to the computation of an experience differential for New York are:

1. The payroll exposure of Schedule Z for each classification.
2. The incurred losses of Schedule Z for each classification.
3. The basic pure premium for each classification.

(*c*) The basic pure premium for each classification should be projected into the payroll for the classification. The sum of the losses produced in this manner for all classifications should then be compared with the sum of actual Schedule Z losses. The result is a differential based entirely upon experience. It represents a measure of the relative cost of compensation under the benefits of the New York Act as compared with the cost of compensation under the benefits of the original Massachusetts Act.

The method may be refined. Thus, the results may be combined by rate groups or by homogeneous groups of classifications and a system of differentials obtained in this manner. As a matter of fact, an experience differential for each classification may be computed by comparing the projected losses for the classification with the actual losses. But the fact that the payroll exposure for indidual classifications is insufficient makes it necessary to group the experience for several classifications in order that a large enough exposure may be obtained to produce dependable results.

During the last conference this method was applied to the experience of all states for which experience was available. Particular attention was paid to the system of differentials for New York because of the high benefits for death and permanent total disability. For New York the classifications were grouped by pure premium symbols, that is, by basic hazard, and a system of five experience differentials was obtained. This system of five differentials was then plotted, a graph constructed and a complete graduation of the differential accomplished by the graphic method. Thus, a law differential was determined for each pure premium symbol. The graph which served as the basis for this graduation is given below:



GRADUATION OF NEW YORK LAW DIFFERENTIAL TABLE.

Pure Premium Group.	Average Pure Premium.	Payroll Exposure.	Differential Value.
.06 — .37	.174	$488,971,477	1.358
.39 — .59	.473	130,128,765	1.620
.61 — .85	.691	104,924,468	1.605
.89 — 1.95	1.311	51,262,738	1.744
2.04 — 7.09	2.500	20,914,701	1.901

It was then recognized that the experience which had been used as the basis for this graduation represented past cost conditions. These cost conditions were for the most part sub-normal. In the first place, a large part of the experience was accumulated during a period of industrial depression. In the second place, the experience covered the first year of compensation in New York and therefore did not represent ultimate cost conditions. The average experience differential for all classifications was 1.60. Computation by the injury distribution method produced a law differential

of 1.89. It was decided that the graduation should produce an average differential for all classifications of 1.89. Consequently, the values for individual pure premium symbols were increased in the ratio of 1.89 to 1.60. In this way experience was supplemented by the assumption of future cost conditions and the system of law differentials was made to represent more nearly the conditions of the future period for which rates were to be projected. This graduated law differential was not adopted by the Augmented Standing Committee as the basis for the projection of New York rates because of the feeling on the part of the majority of the Committee that the Schedule Z experience was not thoroughly dependable, particularly for the high rated and low rated classifications. Furthermore, the Committee took this action upon the ground that the graduation of the law differential made necessary the graduation of other important factors of the multiplier and the time at the Committee's disposal was insufficient for the accomplishment of this work.

There is one serious danger in the use of a system of law differentials by rate groups which should be noted. The basis for grouping is the basic pure premium. The system of differentials, however, is designed to take into consideration the various distributions of injuries by classifications. Inasmuch as the basic pure premium does by no means throw together those classifications which are analogous from the standpoint of injury distribution the scheme fails to accomplish the purpose for which it was intended. A certain pure premium value may be obtained in many ways; in fact any pure premium symbol group will contain a number of combinations of accident frequency, injury distribution and loss cost. Under this plan classifications with identical injury distributions but with different measures of accident frequency, will be thrown into widely separated groups, whereas they should in reality be thrown into a single group for differential calculation. In this respect a system of law differentials by homogeneous groups of classifications is preferable. This would, however, interfere with the retention of the principle of the basic manual. Moreover, difficulty arises when the actuary is called upon to set up homogeneous groups of classifications with our comparatively limited experience to guide him.

The future will undoubtedly bring some satisfactory solution of these difficulties. The development of adequate experience in great

volume is in sight and it is only upon the basis of such experience that we may hope to establish a theory of law differentials which will be scientific as well as adapted to the practical necessities of compensation rate making.

Conclusion.

I have purposely refrained from recommending any particular form of differential or method of differential computation inasmuch as my intention was merely to present a resumé of the work of the Actuarial Sub-Committee of the Augmented Standing Committee as it had a bearing on the theory of law differentials. In this connection, it should be noted that prior to its adjournment the Augmented Standing Committee adopted a resolution which provides that this subject shall be actively studied by the Actuarial Sub-Committee during the coming year. We may, therefore, expect some considerable advancement in the scientific treatment of differential problems by the time the next manual revision is undertaken.

AGE, OCCUPATION AND RESIDENCE AS VARIANTS OF THE RATE OF SICKNESS.

BY

ALBERT H. MOWBRAY.

Unless the extensive discussion and agitation of the problem of sickness loss among the industrial population now going on proves entirely abortive, our profession will soon be called upon to solve some new and very interesting problems in connection with provision for general health insurance. The solution we ultimately reach will obviously be largely influenced by our line of approach and this in turn will depend in no small degree upon our past experience and present association. Thus those of us who have been most closely associated with the business of life insurance and from our knowledge of the basis of calculations in that branch of insurance have come to attach most importance to the age of the insured are apt to carry the same mental attitude into our attack upon these new problems. On the other hand, those of us who have had extensive experience with workmen's compensation and personal accident insurance problems are apt to approach them with the feeling that industry or occupation is the most important factor to be considered.

Perhaps this will be well if enough discussion goes on before matters crystallize too far. Here, I take it, is the most appropriate place for such discussion. We all probably feel that equity requires that in any field of insurance, costs be assessed substantially according to the value of the insurance or the protection given, that is, to the probability of loss, and our difference in point of view is due to a difference in feeling as to the importance of various elements in affecting that probability. (Some of us may concede that in certain circumstances public interest requires a departure from this principle, but it must be clear that if injustice is not to be done some of those involved the extent to which this should go should be determined by the evidence of a paramount public interest.) I have recently been giving some consideration to the subject of health insurance from this point of view, and quite naturally the question

arose, "Which is the most important factor in producing changes in the rate of sickness, age, occupation or residence?"

For commercial health insurance as practiced by those companies doing a general health and accident business this question and others are quite fully answered in the paper, "The Rate of Sickness" (*T. A. S. A.*, X, 371), by the late Hiram J. Messenger, presenting the experience of the Travelers Insurance Company under certain forms of policies analyzed in various ways, among them by age, occupation (in broad divisions) and geographical sections. It must be obvious that selection both through rejection of business offered and refusal to renew except when the company felt the risk was satisfactory played a large part in the development of this experience and that it would be most unwise to draw conclusions from it as to the rate of sickness in general. Mr. Messenger, himself, made that very clear in closing the discussion on the paper at the next meeting. For a study along these lines of the rate of sickness of the general population we must then turn elsewhere. The sources of information respecting the various points discussed are largely European, but from such check data as we have I believe they will not lead us far astray. At any rate we must use what we have. Although the question itself is in a way preliminary and the results obtained are not very conclusive, the material studied and the conclusions to which I believe it points seem of sufficient interest to warrant bringing them before the Society.

Before proceeding further it will be well to define the term "rate of sickness." This is generally taken to mean the average number of days or weeks of sickness per person under observation for one year (annual full-time worker), excluding therefrom all time lost after the first six months (or other prescribed period) from sickness lasting longer than that limit. This limitation is necessary in order to exclude cases of invalidity which it is generally considered should not be covered under the same provision for insurance as the disabilities of shorter duration.

Variation in the Rate of Sickness with Age.

It is a truism to which it is hardly necessary to call the attention of the members of this Society that some insurance benefit is required to bring out the full measure of occurrences of an insurable contingency. There being no general and compulsory indemnity provision in the United States in the case of sickness, it must then

be obvious that we must turn to the published experience of sickness insurance institutions in those countries where such insurance is compulsory and where there is not liberty of contract as to the insurer in order to obtain data which is free from the influence of selection, and which fairly represents conditions which are to be expected under a general compulsory sickness insurance law.

Probably the most useful publication of data of this kind is that of the investigation of the experience of the Leipsig Local Sick Fund published in 1910, and summarized in the 24th Annual Report of the United States Bureau of Labor, Vol. I, beginning at page 1255. From this summary at page 1263 the figures of Table I are taken.

TABLE I.

NUMBER OF DAYS OF SICKNESS PER 100 MEMBERS OF THE LEIPSIG LOCAL SICK FUND, BY SEX AND AGE GROUPS, FOR COMPULSORY AND VOLUNTARY MEMBERS. 1887 TO 1905.

Age Group.	Number of Days of Sickness per 100 Members of Each Class.			
	Compulsory Members.		Voluntary Members.	
	Males.	Females.	Males.	Females.
Under 15 years	595	533	1,639	1,498
15 to 19 years	617	754	2,837	2,375
20 to 24 years	657	955	4,233	2,389
25 to 29 years	708	1,205	2,353	2,367
30 to 34 years	814	1,395	2,115	2,627
35 to 39 years	941	1,465	2,294	2,453
40 to 44 years	1,088	1,453	2,498	2,323
45 to 49 years	1,243	1,496	2,893	2,027
50 to 54 years	1,456	1,490	3,142	2,334
55 to 59 years	1,705	1,486	3,642	2,668
60 to 64 years	2,069	1,632	4,149	3,155
65 to 69 years	2,760	2,373	4,358	3,153
70 to 74 years	3,456	2,531	4,517	3,595
75 years and over	4,043	2,512	4,560	4,575

In order that these figures may be the more readily compared with others from various sources in which the effect of selection is shown, the data for the male compulsory members have been roughly graduated by the graphic method by plotting the sickness rate opposite the central age of the group and drawing a free-hand curve through these points. This curve is shown as the solid line in Chart I accompanying this paper.

Although, as noted above, we have no sickness tables for the

United States based upon coverage of an unselected population, we have for comparison with these figures the results of several sickness surveys undertaken along census lines by the Metropolitan Life Insurance Company under the direction of Lee K. Frankel and Louis I. Dublin. They have tabulated according to age the number of cases of sickness found per 1,000 exposed. In order not to unduly lengthen this paper the figures are not reproduced here but pamphlet copies of the reports of these surveys can undoubtedly be obtained by addressing the company. In the conclusion of the survey of Rochester, N. Y., Messrs. Frankel and Dublin say:

"It is of prime interest to note that the main characteristics of our tabulations agree with those of the leading sickness insurance organizations in Europe. The statistics for the Local Sick Benefit Society of Leipsig, Germany, . . . and other available data present practically the same facts of sickness variation relatively by sex and age as do our results."

It would seem then that we are justified in considering the above rates as typical of the average variation with age of the rate of sickness in the industrial community as a whole. Taking them as such we may learn something of the effect of selection by comparing with them the sickness rates of the following experiences:

(*a*) That with the voluntary membership of the Leipsig Fund.
(*b*) That of the British Friendly Societies.
(*c*) That of a large and progressive American manufacturing company.
(*d*) That of the American insurance companies with one-year term contracts.

(*a*) The data with respect to the voluntary membership of the Leipsig Fund has already been presented in Table I. As I understand it, the Fund can not refuse to insure these voluntary members and on the same page of the Report of the Bureau of Labor on which the data are given is the following comment:

"For the male voluntary members the rate shows the effect of the presence of the less desirable insurance risks; the number of days of sickness increases rapidly up to the twenty-fourth year of age, when there is a sharp decrease. In the text of the report this is explained as follows: Practically all the male population, including the weaker and those who are physically less valuable, are sent to work in the earlier ages; in a few years, however, the weaker persons must give up the occupations in which they are engaged, but realizing their need for insurance, continue their membership as

voluntary members. In the higher ages the voluntary members are also below standard physically, but the fact that they have been engaged in industrial occupations for a number of years proves that they are physically somewhat stronger than the voluntary membership composed of the younger age classes."

Further comment upon this comparison appears to be unnecessary. As this is perhaps the least important of this series of comparisons and the rates are so much higher than those in all the others, they are not shown in the chart.

(*b*) The British Friendly Societies are voluntary organizations with a long and honorable record of usefulness. A number of papers dealing with their operations and experience will be found in the *Journal of the Institute of Actuaries* and more recently there has been given under the auspices of the Institute a series of lectures on Friendly Society Finance by Mr. Alfred W. Watson, Actuary of the Manchester Unity (I. O. O. F.), the largest of these societies. Mr. Watson also presented a paper dealing with this subject before the Fourth International Congress of Actuaries at New York, 1903, published in the *Proceedings* of that Congress, Vol. I, beginning at page 478. From this paper (page 482) the figures in Table II following have been taken.

TABLE II.

MANCHESTER UNITY EXPERIENCE, 1893–97. ENTIRE MEMBERSHIP.
Annual Sickness per Member.

Age.	In Weeks.	In Days (7 Days per Week).
22	.85	5.95
27	.86	6.02
32	.92	6.44
37	1.02	7.14
42	1.19	8.33
47	1.39	9.73
52	1.71	11.97
57	2.22	15.54
62	2.99	20.93
67	3.94	27.58
72	4.80	33.60
77	5.01	35.07

In connection with these figures it should be borne in mind that the Manchester Unity is a large society operating on the lodge plan much as do our own fraternal orders. The contracts are not term contracts as in the case of our personal accident companies, but the membership is continuous. The members are admitted on the basis

of acceptability to the local lodge and the order as a whole and the lodge system of administration, by reason of the personal interest of all the members, tends to a reasonably careful claim administration. The figures in Table II are those for the first twelve months of disability only. After six months of sickness the benefits are reduced one half and there is a further reduction at the end of one year. This, therefore, is a natural division point. It is my understanding that industrial accidents were covered under this experience the same as other disability. In comparing these figures with

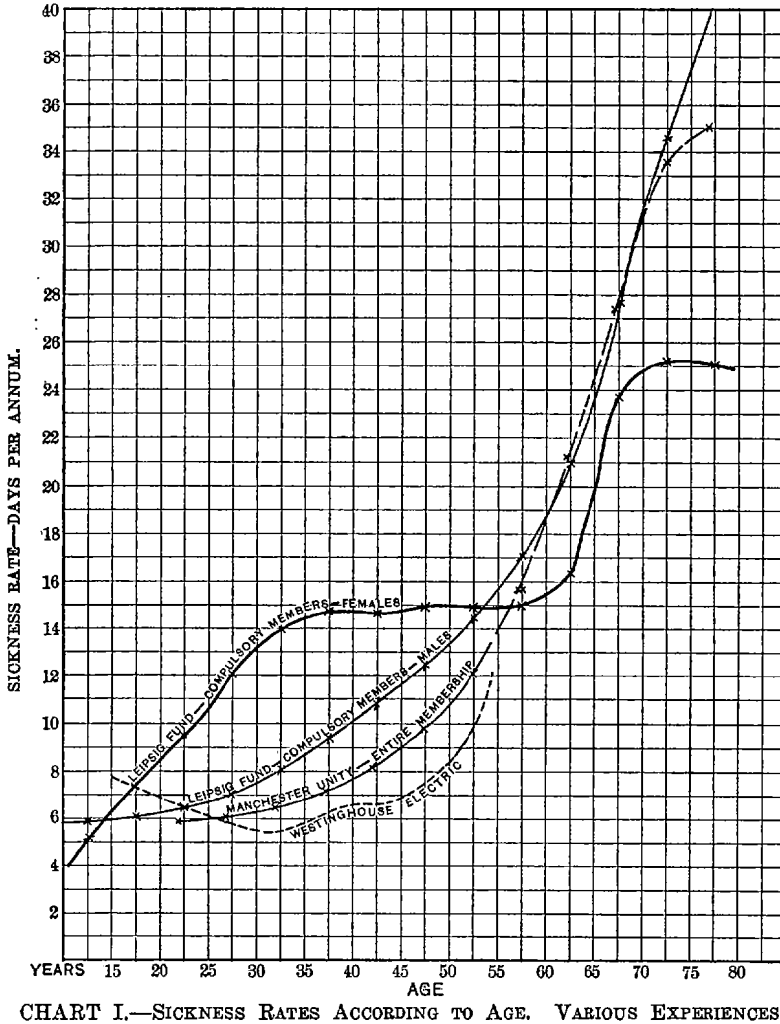


CHART I.—Sickness Rates According to Age. Various Experiences.

those in Table I it should be remembered that the Leipsig Fund pays benefits only for thirty-four weeks, and in the case of industrial accidents only for thirteen weeks (24th Annual Report, U. S. Bureau of Labor, page 1197). To facilitate comparison these figures have been plotted on Chart I. They are represented by the broken line.

In addition to these figures Mr. Watson gives other tables which show the steady rise in the rate of sickness disclosed by successive investigations of Friendly Society experience, which it would be interesting to reproduce here as would be other data cited to show the effect of differences in type of benefit and method of operation. Such reproduction would unduly lengthen this discussion and lead somewhat away from our main question. Members interested are, therefore, referred to Mr. Watson's paper for them.

(*c*) For some years the Westinghouse Electric and Manufacturing Company has maintained a Relief Department and the Westinghouse Air Brake Company a Relief Fund. The experience of the former has been brought down to the close of the year 1913, and of the latter to the close of the year 1912. Disability rates derived from these data, graduated by King's method, are contained in a paper, "Sickness and Accident Disability Tables," by Mr. Miles M. Dawson, presented at the last meeting of the Actuarial Society of America and published in *T. A. S. A.*, XVII, 274. Both sickness and accident disability are included for disability up to 39 weeks, but no disability after 39 weeks was considered in compiling the rates. At the important ages these rates are lower than the M. U. rates quoted above, being about equal to the earlier rates deduced by Mr. William Sutton from the combined experience of all the Registered British Friendly Societies from 1856 to 1880, and published in *J. I. A.*, XXXIII, 268. The figures are not presented here in tabular form but the rates for the electric company, the larger of the two, are represented on Chart I by the dotted line. In the absence of any comment from Mr. Dawson indicating that these companies handle their relief departments in an essentially different manner from other similar American large corporations, the figures may perhaps be safely taken as typical of the experience of this type of companies. The effect of occupation, to be further discussed later, must not be overlooked in this connection.

(*d*) So preponderant a proportion of the data analyzed by Mr. Messenger in the paper referred to above was drawn from the pro-

fessional, clerical and commercial classes that it is hardly to be compared with that of any of the other investigations we have noticed. In one section of the business, however, the industrial classes did predominate, viz., the instalment section. Concerning this Mr. Messenger says:

"The experience in Column F., which represents insurance on industrial classes (largely railroad men) under the special health contract, and under Column G., which is practically the same thing with one year's experience added, shows a nearly uniform rate of sickness up to age fifty and then quite a decided increase except for ages above fifty-five, where the exposure is too small to be given much consideration."

The actual values of rates of sickness shown in Mr. Messenger's paper are not comparable with those quoted above, as complete coverage was not given under the policy. For this reason they are not shown in Chart I. Their importance for us in the present connection is their indication that the effect of selection and administrative methods may be to entirely prevent the normal increase of the sickness rate with age.

From a study and comparison of the above noted data we seem to be justified in drawing the following conclusions respecting the variation of the sickness rate with age:

1. In a general population the rate of sickness increases with age in a regular progression. The curve is not so steep as the mortality curve, but such that substantial reserves would be required at the older ages under any system of insurance covering the whole of life at a level premium based on the age at entrance.

2. The rate of sickness to be experienced may be much reduced by effective selection on entrance and close supervision of claims and the curve considerably flattened until the older ages are reached.

3. Under the one-year term system careful selection on renewal may make age a negligible factor until the older ages are reached, i. e., 55 and over.

Variation of the Rate of Sickness with Occupation.

In the summary of the Leipsig experience in the Report of the U. S. Commissioner of Labor, above referred to, there is (pages 1281–1341) an analysis of the experience by certain large industry groups and by age groups, showing for each industry division the days lost per thousand persons exposed for several decennial age groups, as well as for the entire industry group. As the age com-

position of the groups was of course not uniform, this latter figure did not seem the proper one to use for comparison. The following method was used to get figures which would be freer of this influence and which might, therefore, be considered a truer index of the value of occupation as a variant of the rate of sickness:

For each decennial age group the days lost were compared with the days lost per thousand exposed for the entire membership and the percentage noted. The average of these for the five decennial groups, 15–24, 25–34, 35–44, 45–54, 55–61, was then taken as the index for the occupation group. It is recognized that this method may be subjected to some criticism, but it seems sufficient for the present purpose, which is only to obtain a rough general indication of the relative sickness rate for the several industry divisions. The results of this study are given in Table III following. Although data was given for female workers in certain industrial groups, only the data respecting male members was used in this study.

TABLE III.

VARIATION OF THE RATE OF SICKNESS AMONG MALE MEMBERS OF THE LEIPSIG LOCAL SICK FUND ACCORDING TO INDUSTRY GROUPS.

Group.		Ratio Sickness Group to Total Per Cent.
(*V*)	Office, etc., salesmen, etc.	61.2
(*W*)	Engineers and firemen, all industries	72.7
(*F*)	Fats, oils, paints, etc.	80.0
(*E*)	Hides, leather rags, etc.	82.6
(*L*)	Musical and chronological instruments	85.6
(*B*)	Hotels and restaurants	87.0
(*O*)	Food and drinks	90.0
(*C*)	Clothing and cleaning	90.2
(*S*)	Textiles	92.3
(*H*)	Gas works	93.7
(*G*)	Gardening, agriculture and forestry	94.9
(*K*)	Wood and cut materials	98.7
(*T*)	Transportation	99.4
(*D*)	Chemical industries	101.7
(*M*)	Leather, etc., products	102.0
(*J*)	Glass, porcelain, etc.	104.9
(*Q*)	Printing and publishing	107.1
(*Y*)	All others	108.4
(*A*)	Building trades	111.3
(*P*)	Paper industry	113.7
(*N*)	Metal working	117.2
(*U*)	Cement and lime	130.6
(*R*)	Stoneworking	155.9

In studying this table it should be kept in mind that only sickness of less than a certain duration is considered. This table is, therefore, no safe guide to relative occupation ratings where invalidity is also to be covered and this observation is true as to all material cited in this paper.

In addition to this material there is given for the Leipsig Fund (pages 1342–1347) data as to forty-one individual occupations chosen so as to represent a wide range of common occupations. This is in two sections each for males and females from age twenty-five to age thirty-four, and from age thirty-five to age fifty-four. The rate of sickness for males in the first group varies from 3,680 days of sickness per 1,000 persons exposed for the group, "shop employees, salesmen, clerks, etc.," with 4,071 exposure years, to 12,285 days of sickness per 1,000 persons for the occupation "sculptors in stone, marble, etc.," based on an observation of 2,754 exposure years. The particular occupations enumerated in the list is probably of less interest than the fact that between important and common occupations there exists at this age interval a range of variation of nearly 350 per cent. taking the lowest as the base.

I have arranged these occupations in order according to the rate of sickness, beginning with that for which it was the least, and plotted the rates of sickness in Chart II herewith. For comparison with the points so charted, I have plotted on the same chart the sickness rates for the same occupations in the age interval 35 to 54. It will be observed that the order of progression in seriousness is in general the same as for the younger age group though there are some marked reverses. This may be due in part to accidental variations introduced by the rates quoted being based upon limited observations. It is undoubtedly due in large part to a greater or less rapid deterioration of the workers in one industry as compared with another. The capacity requirements of the several occupations also have an undoubted effect. In some occupations men whose health causes much loss of time cannot be used, while in others the necessity of such absences do not require their retirement. Hence, there tends to be a transfer of weaker workers from the former type to the latter. Again it must be borne in mind that we are considering temporary sickness only, and that if invalidity were included the showing of particular occupations might be quite different.

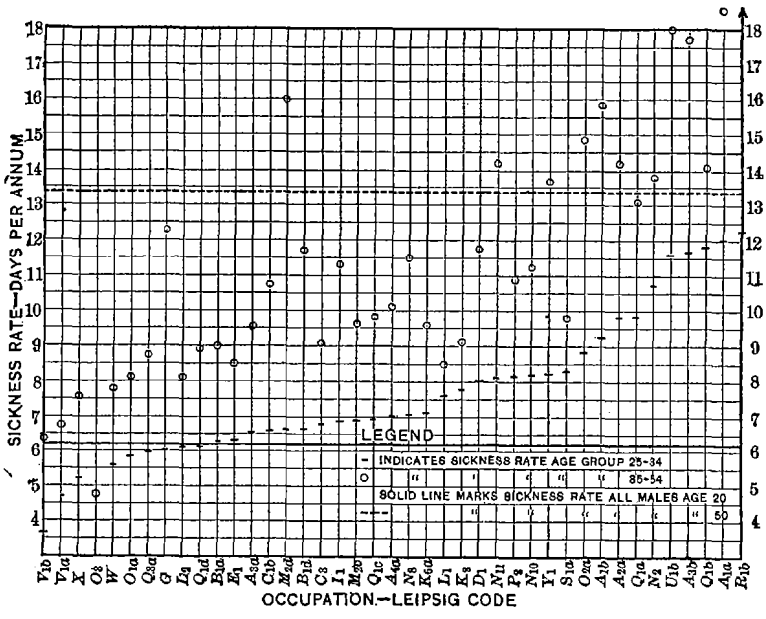


CHART II.—SICKNESS RATES BY OCCUPATIONS. LEIPSIG FUND EXPERIENCE—MALES.

Turning to the data of the British Friendly Societies in this regard, we find that in his paper from which we have heretofore quoted, Mr. Watson says:

"In the most recent investigation of the Manchester Unity Experience (1893–97) the data were divided, with reference to occupations, into the following eight classes:

"*HJ.* The 'normal' class, including all persons engaged in occupations considered to be devoid of special features so far as concerned the risk of incapacity.

"*A.* Persons engaged in agriculture.

"*B.* Persons engaged in certain occupations entailing much exposure to weather, but without particular risk, such as building-trade operatives, urban laborers, canal boatmen, and laborers and dock workers. It was considered probable (and the results seem to establish the correctness of the anticipation) that the lack of continuity in many of these employments would exercise a detrimental effect on the claim rates. It is one of the difficulties attendant on the operations of friendly societies that when work is slack, claims are much above the average.

"*C.* Persons engaged in the railway-transport service.
"*D.* Persons engaged in seafaring, fishing, etc.
"*E.* Persons engaged in quarry work.
"*F.* Persons engaged in iron and steel works, foundries, chemical and glass works, and other industries demanding great and continuous physical exertion with exposure to intense heat or other trying atmospheric conditions.
"*G.* Persons engaged in mining.

"A critical examination of the sickness rates of these classes led to the amalgamation of those designated *A* and *HJ*, of *B*, *C*, and *D*, and of *E* and *F*, Class *G* standing alone as presenting the maximum sickness liability discovered.

"Examples of the several rates of claim as finally deduced are shown in Table VI.

"The differences here shown scarcely call for comment; the effect of the varying incidents of occupation is apparent.

"A minor but interesting point disclosed by this inquiry was that the extra risk of occupations presented itself in the form of an increased number of claimants rather than in an increase in the average length of claim."

The table referred to by Mr. Watson as "Table VI" is here denominated as Table IV.

TABLE IV.

SICKNESS RATES IN WEEKS PER MEMBER PER ANNUM, SHOWN BY THE MANCHESTER UNITY EXPERIENCE, 1893-97, IN CLASSES ACCORDING TO THE OCCUPATION.

Ages.	Classes A, H J.		Classes B, C, D.		Classes E, F.		Class G.	
	First 12 Months of Sickness.	After 12 Months of Sickness.	First 12 Months of Sickness.	After 12 Months of Sickness.	First 12 Months of Sickness.	After 12 Months of Sickness.	First 12 Months of Sickness.	After 12 Months of Sickness.
22....	.77	.04	.90	.05	1.13	.07	1.39	.07
27....	.78	.09	.92	.08	1.13	.16	1.50	.16
32....	.83	.14	1.02	.15	1.24	.20	1.61	.22
37....	.92	.22	1.18	.27	1.41	.28	1.79	.47
42....	1.09	.35	1.35	.40	1.60	.52	2.04	.67
47....	1.27	.53	1.61	.69	1.80	.70	2.42	1.04
52....	1.60	.94	1.94	1.18	2.08	1.16	2.93	1.94
57....	2.07	1.69	2.55	2.04	2.76	2.18	3.62	2.92
62....	2.80	3.09	3.40	3.82	3.84	4.46	4.63	6.59
67....	3.82	6.33	4.16	7.88	4.88	9.42	5.24	12.22
72....	4.74	12.11	5.09	15.21	5.41	17.26	4.78	22.48
77....	5.09	19.97	4.85	23.16	4.74	26.48	3.58	26.41
82....	4.50	27.96	3.87	30.81	4.69	36.33	3.47	35.46
87....	3.67	32.45	3.60	33.78	4.50	40.42	3.64	36.00

As respects occupation, Mr. Messenger only analyzed his data into five groups, (1) Professional and Clerical. (2) Industrial

(indoors). (3) Industrial (outdoors). (4) Commercial Travelers. (5) Liquor Business. It must be evident that we are, therefore, not in a position to compare the Travelers' experience with the others as respects the variation of the rate of sickness with occupation.

From a study and comparison of the above data we are perhaps warranted in coming to the conclusions that:

1. The extent of variation in sickness rates with occupation is much greater when individual occupations are used as the basis of distinction than where the industry in which the worker is employed is the basis.

2. The extreme limits of variation with the individual occupation are much further apart than are the limits of variation with age for the more important ages, though the difference is not so great as between the sickness rates for the ages 20 to 30 and those for ages 70 and over.

3. When the basis of distinction is the large industry group, a general population experience such as the Leipsig experience will show about the same limit of variation as between the sickness rates for the limiting ages for the more active period of life, say 20 and 55.

4. In an experience such as that of the British Friendly Societies where selection of membership takes place the variation with occupation, using large groups as the basis of study, will be less wide than with age. Of course, this assumes a similar selective policy to that of the Manchester Unity, or a tendency for the society to follow certain trade lines in securing its membership.

Variation in Sickness Rate According to Residence.

There seems to be less satisfactory data for the study of variation of the rate of sickness according to residence than for the study with respect to age or occupation. At least I have not been able to find much material and such as I have found only permits study on very broad lines.

For comparison with the data of the Leipsig Fund we have in the *Proceedings* of the Fourth International Congress (Vol. I, page 468) a brief note by Dr. J. P. Janse, Actuary of the "Orange Nassau" Life Insurance Company, Amsterdam, comparing the experience of certain very similar sickness institutions in Switzerland, Holland and Austria. Almost no information is given as to

the operations of the several funds whose experience is compared, although Dr. Janse says of the Swiss and Dutch data, "Both tables of sickness have been derived from statistics of cases of sickness among persons who are in much the same conditions of life."

As will be seen from an inspection of Table V, taken from this note, and comparison of the rates with those of the Leipsig Fund, it would appear that the variation between places is relatively slight. We must however make due allowance for our lack of knowledge of the precise conditions under which these rates were developed.

TABLE V.

COMPARISON OF SICKNESS RATES IN VARIOUS EUROPEAN COUNTRIES.

Age.	Switzerland.	Holland.	Austria.
20.....	5.39	4.77	6.2
25.....	4.85	5.02	6.1
30.....	5.41	5.47	6.8
35.....	6.48	6.26	7.6
40.....	7.24	7.25	8.5
45.....	7.96	8.06	9.6
50.....	9.82	9.22	10.7
55.....	12.92	12.14	12.5
60.....	16.12	16.26	15.2
65.....	19.32	20.42	19.2
70.....	22.59	27.35	24.2

Mr. Messenger has analyzed his data, which comes from an exclusively American experience, into three sections according to geographical divisions, North, South and West. With respect to this he says:

"The geographical divisions of this experience show that there is very much less sickness in the north than in the south, with the west not as favorable as the north, except in the case of the general health policy where the showing for the west on a very small exposure (only one hundred and eighty years) is exceedingly favorable. This variation in the rate of sickness in the different sections of the country—with the north giving invariably better results than the south—is confirmed by the Travelers' experience in other lines of business. The Travelers' life experience shows the highest mortality rate in the south, the lowest in the north and an average rate for the west; and, a similar statement can be made in regard to the loss ratios of the Travelers' business in its accident and liability lines."

From personal observation while resident in one of the southern states, I am inclined to believe that a part of this showing is due

to the inability of that company, or any company, to secure in that section an agency staff which would be as effective in securing a carefully selected line as in other sections of the country. Mr. Messenger also analyzed the experience according to whether the insured lived in a town or city of 25,000 or more inhabitants or in communities of under 25,000 or the rural districts. This showed a considerably lower sickness rate for the former than the latter. We have not enough other data to indicate how much of this effect was due to a less rigid selection and how much to a real difference in the rate of sickness.

Examining the sickness surveys of Rochester, N. Y., Boston, Mass., and the state of North Carolina made by the Metropolitan Life Insurance Company, we note a finding of sickness among males 15 years of age and over as follows:

TABLE VI.

SICKNESS REVEALED BY SURVEYS OF THE METROPOLITAN LIFE INSURANCE COMPANY.

Location.	Date.	Total Sick per 1,000 Persons Observed.	Unable to Work per 1,000 Persons Observed.
Boston, Mass.....	July 17–24, 1916	24.3	21.6
Rochester, N. Y.....	Sept. 13–20, 1915	27.3	23.2
No. Carolina.....	April 17–24, 1916		
		White, 31.4	25.4
		Colored, 28.9	24.6

These results are in line with those reported by Mr. Messenger, but the variation is not so marked. They indicate that residence influences the variation in the sickness rates less markedly than either age or occupation. This conclusion cannot, however, be relied on so confidently as with respect to the other factors, due to the necessary limitations of the census method.

CONCLUSION.

In closing this discussion, I must express my regret that I am not able to present any new material bearing on the important problems before us. Further search might have revealed further material as valuable or more valuable than that here noted. I trust that some of our younger members with less pressure upon their time may be induced to make further search, as I do not feel that

the question that prompted this investigation has been sufficiently answered by this rather preliminary survey of the ground. The actual basis of rate determination that will be adopted if we are called upon to freely cover the contingency of sickness must of necessity be largely determined by the administrative machinery provided for such coverage. It seems to me that if the problems of sickness insurance are to be correctly solved, the factors above considered must be weighed very carefully in formulating legislation. To cite but one instance of difficulties encountered in meeting them when they are not provided for in the basis of rates, we may point out that in Great Britain, where the contribution from the insured, his employer and the state are fixed in amount regardless of age, occupation or residence of the insured, and where it is optional with the worker where he will be insured, a very cumbersome system of reserve or transfer value accounting between the government and the approved societies has been necessary in order that societies composed largely of young members may not receive an unduly large share of the government contribution at the expense of those composed of older members. It has further been necessary to provide for deposit insurance, a sort of savings bank arrangement, for those who cannot obtain insurance with an approved society. It is also my understanding that some of the societies whose membership is largely drawn from those occupations where the sickness rate is low have found the rates sufficient to permit benefits in excess of the minimum prescribed by law and others whose membership is drawn from less healthy occupations are finding the rates insufficient to provide such minimum benefits.

I have no desire to start a partisan debate here by raising questions with respect to which our professional judgments can not but be influenced by the interests of the companies with which we are associated. Hence I refrain from pursuing this line of discussion further. Probably enough has been said to make clear to any reader the importance of a thorough study of the problem of all variations in the rate of sickness and the causes thereof, as well as the relations of these to the problems of insurance organization and rate-making.

PROSPECTS FOR SOCIAL STATISTICS IN THE NEXT CENSUS YEAR.

BY

EDWIN W. KOPF.

A complete classification of social facts in a discussion on prospects for social statistics in the next census year would probably not serve the practical interests of casualty statisticians and actuaries. The number and complexity of social phenomena, and the lack of precise means for measuring or gauging social forces, are two essential checks and limitations upon our inquiry. Our interest must be confined to those facts in the life of organized society which can be readily recognized as "insurable incidents," or as necessary aids to a proper understanding of these "insurable incidents." The comprehensive summaries of social statistics subject matter arranged by Schäffle* and by Spencer† would not be entirely suitable for our inquiry. We shall profit most from a consideration confined to static and dynamic demology with perhaps a supplementary reference to the elements of economic statistics.

The syllabus of our Society limits our attention to the social circumstances which systems of accident and health, liability, fidelity and surety, burglary, credit, and in somewhat subordinate degree, life insurance seek to indemnify. The statistical facts which provide a broad foundation for the later actuarial treatment of the strictly insurance aspects of these phenomena, might be conveniently arranged as follows:

Static Demology—

Structure, or composition, of population according to sex, age, marital condition, race, nativity, occupational, defective and dependent, religious profession, educational and other social classes.

Dynamic Demology—

Movement, or functioning, of population through births, marriages, divorces, sickness and accidents, deaths, crimes, offenses and delinquencies, and migration.

* Schäffle, Albert E. F., "Bau und Leben des sozialen Körpers."

† Spencer, Herbert, "Descriptive Sociology."

Selected Elements of Economic Statistics—

Wages, hours of labor, housing of the wage earning classes, employment and unemployment, superannuation, pensions, progress of workmen's insurance, poverty and pauperism, savings and investments of the wage earning classes, constructive philanthropy.

Social statistics for recent years bear little relation to a general plan of social study. The chief function of committees of American learned societies which are at present contemplating discussion of plans for statistics in the next census year, is to draw up a schedule of minimum requirements in a single programme. This programme should reasonably express the wishes of the societies acting jointly in such manner as to prevent overlapping, or emphasis upon trivial or non-essential matters.

The interests of the Casualty Actuarial and Statistical Society in static and dynamic demology are, perhaps, nearly identical with the general aims and purposes of the committee appointed over a year ago by the American Public Health Association to consider the vital statistics of the next census year.* Numerous special aspects of vital statistics, when defined as static and dynamic demology, are only of passing interest to the Public Health Association Committee, however. These special problems are, on the other hand, of the first importance to the casualty statistician and actuary. The Public Health Association Committee will consider life tables for the triennium 1919–1921, for instance; the uses of these tables for purposes of compiling, say, a morbidity table as a foundation for sickness insurance premium rates would probably not be anticipated by any one save by the casualty statistician and actuary. Statistics of marriage and remarriage at the several age classes, should be provided for; but the need for statistical material of this kind would not become apparent to a committee authorized to consider mainly the public health aspects of demology.

The American Public Health Association Committee on Relation of the 1920 Census to Vital Statistics (demology) has in circulation for criticism among its members, and in preparation for the first meeting of the committee, a list of topics and a reasonable amount of comment under each topic. With the permission of the chairman of that committee, I am giving an abstract from parts of this preliminary draft:

* Calendar Year, 1920.

(*a*) *Scope of Vital Statistics.*—The American Public Health Association Committee was asked to consider whether vital statistics should discuss only the *movement* of population or whether it should in addition comprehend a discussion of the *structure* of population. Individual topics not provided for in any public or private publication of the last census year, and suggested for discussion in connection with public and private statistical work in the forthcoming census year, are given below.

(*b*) *Marriage Statistics.*—The utility of statistics of remarriage at the several age classes of widows and widowers, in special relation to pension and workmen's compensation problems, was pointed out. The Casualty Actuarial and Statistical Society of America might consider this phase of marriage statistics more closely than will be possible in the deliberations of the American Public Health Association Committee.

(*c*) *Sickness Statistics.*—The recommendations under this head will be of prime interest to casualty statisticians and actuaries. The subject was divided into the following main classes:

1. Institutional sickness and mortality statistics.
   General hospitals,
   Special hospitals,
   Correctional and penal institutions,
   Institutions for the aged and infirm.
2. Community surveys of sickness and disability.
3. Areas of known disease prevalence. Reportable diseases.
   Working of the Model State Law for reporting of sickness. Standardization of sickness statistics tables.

The draft directs attention to the lack of qualified sickness statistics in census or other sources for the last census year. It recommends an inquiry into the practical working of the so-called "Model Bill" for the reporting of certain diseases, including occupational diseases, suggests a Federal Registration Area for general and special hospital statistics and outlines the possibilities for community surveys of sickness in representative areas. Practical means of overcoming the difficulties of nomenclature and classification of diseases and of transmitting the tabulated information for cooperating hospitals to a central agency are advanced. It was suggested that the United States Public Health Service undertake to collect these institutional sickness statistics. Community surveys of sickness were urged.

At the fourteenth annual meeting (1916) of the Conference of State and Territorial Health Officers a resolution was passed recommending the formation of an "Area of Known Disease Prevalence"; another resolution of the fifteenth conference, April 30–May 1, 1917, urged the adoption of standard tables for the recording of sickness statistics for this "Area." At the same conference a paper was read on "The Need for a Federal Voluntary Registration Area for Hospital Sickness Statistics." It is anticipated that active work will be initiated shortly on the formation of this registration area for hospital sickness statistics.*

(*d*) *Vital Statistics in the Service of Social Reform.*—The committee was reminded that conference with statistical, actuarial, labor legislation and sociological societies on this subject was imperative. Published vital statistics are used in too many instances to support programmes of remedial action which are not justified by the inherently limited data employed.

(*e*) *Vital Statistics of Insurance Societies.*—The coöperative statistical study of insurance mortality, sickness and accident experience in the census year was recommended. This work could be accomplished by the insurance societies. Workmen's compensation industrial accident statistics were included in this group of auxiliary sources of statistical information.

(*f*) *Vital Statistics of Industries.*—Analysis of statistical data on physical examination of workmen and of establishment pension and benefit funds was recommended.

(*g*) *Revision of Nomenclature and Classification of Diseases and Conditions, and of Accidents and Injuries.*—Establishment of a suitable nomenclature and classification of diseases and conditions, and especially of accidents and injuries, based upon the present International List of Causes of Sickness and Death, the forthcoming report of the United States Public Health Service Board of Nomenclature, the Report on "Statistics and Compensation Insurance Cost" of the International Association of Accident Boards and Commissions, and the Bellevue and Allied Hospitals nomenclature, was urged. The needs of the decade 1920–1929 were anticipated.

(*h*) *Revision of Nomenclature and Classification of Occupations*

* See forthcoming *Transactions* of the 15th Annual Conference of State and Territorial Health Officers, Washington, D. C., April 30 and May 1, 1917, United States Public Health Service, Wash. D. C., 1917. Also, *United States Public Health Service Reports*, June 15, 1917.

and Industries.—Dissatisfaction with the classification used in the published volume on occupation statistics of the thirteenth census was indicated and the revision of the classification in line with the principles of the International Statistical Institute List was urged.

(*i*) *Life Tables for the Triennium 1919–1921.*—Casualty statisticians and actuaries will be interested in the recommendation for United States Life Tables at the next Federal Census. (The utility of such tables in the computation of morbidity tables for a general population was demonstrated by the Swiss statistician Jester.*) Our Society should inquire into the application of United States Life Tables to the derivation of suitable morbidity tables in anticipation of a need for such material in the decade 1920–1929.

There were other detailed references, in this preliminary draft, to special subjects in demologic sociology for the attention of the American Public Health Association Committee. It will be impossible for that Committee to consider the insurance bearings of this material. The Casualty Actuarial and Statistical Society should take up the discussion from the viewpoint of the utility of demologic data in the actuarial work in prospect for the next census and ensuing years.

Selected Elements of Economic Statistics.

Social statistics may be conveniently considered to include, for our purposes, certain selected elements of economic statistics by the same token that sociology is sometimes assumed to comprise economics in its supporting categories. A few brief comments will suffice to show the importance of relating plans for general social and detailed economic statistics in the census and succeeding years.

(*a*) *Wage Statistics.*—Casualty statisticians and actuaries will probably not be interested in wage statistics beyond the immediate application of such data to the solution of rating and administrative problems in workmen's compensation or other forms of workmen's insurance. The discussion of plans for wage statistics in the study of the distributive processes in the economic life of man is properly a question for the American Economic Association. Our Society should determine upon the way in which it desires wage statistics to be published, perhaps, to show:

* Jester, E., "The Mathematical Basis of Sickness Insurance." *Journal of the Swiss Statistical Society*, 1913, p. 493.

1. Wages in principal occupations, with respect to sex, broad age classes, and geographic areas.

2. Relation of money wages to real wages and the correlation of real wages with other economic phenomena.

(*b*) *Hours of Labor.*—Statistics of hours of labor are necessary adjuncts to the reflective study of the wage factor in workmen's compensation and other insurance problems. Statistics of production and wages, related to hours of labor and the numbers of persons employed, would establish facts on the "intensity of labor." Such facts would go far to explain phenomena observed by Messrs. Mowbray, Black and Beyer (*Proceedings,* Vol. II, p. 418) and others in workmen's compensation experience.

(*c*) *Prices, and the Cost of Living.*—Casualty statisticians will be interested in the methods and results of price statistics as of use in determining the general effect of changes in the price-level upon the several classes in the community and on the economic well-being of the entire community. Cost of living statistics enter into the discussion of real wages, of course.

(*d*) *Employment and Unemployment.*—The unemployment problem of the winter of 1914–1915 directed the attention of most statisticians to the necessity for comprehensive and conclusive statistics of employment and unemployment. While unemployment insurance has so far received little notice from American statisticians and actuaries, the subject is likely to appear as a stated problem for them sooner or later.

The statistical situation should be thoroughly canvassed in anticipation of rating and administrative problems. The several methods of ascertaining the extent of unemployment (1) by inquiry through census enumerators as to how many days each individual of working age lost during the year ending with census day, (2) by determining how many persons are unemployed on the census day, (3) by canvassing employers and tabulating from their records the fluctuating number of employees during the year, (4) by collecting trades unions' unemployment figures and (5) by special inquiry of philanthropic and charitable societies during times of distress, should be examined. The insurance statistician and actuary will find that these methods serve different purposes; an attempt should be made to gauge the validity and establish the insurance uses of the several classes of unemployment data.

(*e*) *Wealth, Poverty and Pauperism.*—Discussions on the eco-

nomic foundations of workmen's insurance very nearly always contain references to more or less misleading statistics of wealth, incomes, poverty and pauperism. Our Society should participate in some plan for gathering qualified statistics on these subjects. Attention is directed to Professor Willford I. King's suggested scheme,* which would facilitate the approximate determination of net family assets and of the incomes of individuals, partnerships and corporations. The available statistics, and any suggested plans for the improvement of information on national wealth and incomes, should receive the consideration and criticism of the casualty statistician.

Statistics of poverty, such as presented by Booth† for the social classes of London and by Rowntree‡ for York, England, are not available for the United States. An application of the methods of these two investigators to American problems is suggested.

Statistics of pauperism, and on the proximate causes of this social phenomenon, are available in a number of State publications (for Massachusetts, New York, Connecticut and Indiana). The United States Bureau of the Census publications on paupers in almhouses (1904 and 1910) also give data of value in the study of this problem. The casualty statistician must, however, examine these data to see how far they serve his general purposes. A fruitful field of inquiry is offered in the statistics of charity organization and other philanthropic societies. The place of the "insurable incidents" of sickness, accident, death of the breadwinner, unemployment, and premature industrial superannuation in the primary causation of poverty and pauperism, can probably be determined from a survey of the activities of these societies. The pioneer work of Amos Griswold Warner§ and John Koren in the statistical study of charity organization case records provides the point of departure for further investigation.

(*f*) *Savings, Investments and Insurance of the Wage Earning Classes.*—The recent savings bank centenary suggests a statistical review of the savings bank movement, especially as it relates to the growth of thrift among the wage earning classes during the past century. The questions of wage earners' investments, the building

* "Statistical Data on Wealth and Income," *Quarterly Publications* of American Statistical Association, Vol. XV, No. 117, March, 1917.

† Booth, Charles, "Life and Labor of the People in London," Vol. II.

‡ Rowntree, B. Seebohm, "Poverty. A Study in Town Life."

§ Warner, Amos G., "American Charities."

and loan movement, cooperative purchasing societies and industrial life insurance should be adequately provided for in a programme of study of voluntary savings and thrift agencies. The supply of facts is at present almost entirely lost from view in the official reports of the banking and insurance departments of our American Commonwealths. Thrift studies should be related, too, with wage data.

From this brief summary of the main topics in social statistics it will be evident that further and more critical consideration must be given to the subject from the viewpoint of the casualty statistician and actuary. As Arthur Richmond Marsh has pointed out. . . . "In the brief space since the last census year, both the scientific importance and the practical uses of social statistics have become vastly better known in this country, and the number concerned with such statistics has enormously increased. On the one hand, the partial introduction into the United States of the so-called social insurances, and the pressure for the adoption of a complete round of these insurances have brought home as never before . . . the indispensableness of important varieties of social statistics. . . ." The members of our Society who have given thought to the fundamentals of casualty and social insurance subjects must be impressed with the lack of coordination of such social statistics as are available, and with the utter absence of material practically indispensable for an elementary statistical understanding of the social facts which casualty and social insurance is supposed to indemnify.

I would therefore recommend that our Society actively participate in consideration of plans for public and private statistics for the next census year in cooperation with the Committees appointed by the other American scientific societies,—the American Public Health Association, American Statistical Association, American Economic Association and the American Association for Labor Legislation. The Casualty Actuarial and Statistical Society would do well to confine its field of investigation to social statistics and to consult frequently with representatives of the other Societies in order not to duplicate effort or confuse the preparation of a joint report.

Oral Discussion.

Mr. Leonard W. Hatch: Mr. President, I would be more interested in hearing a discussion than in speaking. However, I will say just a word.

My impression, as a result of use I have made of census figures not only in connection with the matter of accidents but also as related to occupational diseases and in relation to industrial and labor statistics generally, is as follows. Up to the present time the census figures have largely proceeded along certain lines established some time ago and continued with a view to keeping up comparable figures, and getting figures that would be comparable over quite a period of years. It is always true when much weight is given to that consideration, that statistics tend to be unprogressive owing to constant reference to the beginning of the series, when the statisticians who started the work could not foresee future developments. Now the figures of the Federal census are about the only source from which we are going to get national statistics along a good many lines. These Federal census figures are not going to be improved until we can bring to bear upon the census officials and the census work the pressure of opinion from organizations such as this Society. There is already under way in a number of other organizations a movement to bring to bear a good deal more pressure of that kind for the 1920 census than has ever before been exerted. The American Economic Association and the American Statistical Association, I think the American Association for Labor Legislation also, and the Public Health Association, all have committees at work now outlining what they regard as fundamental that the Federal census should cover in 1920.

I have had some connection with the joint committee of the Economic Association and the Statistical Association on Federal statistics. I am pretty sure that the 1920 census will follow pretty closely the old lines unless societies such as this, and all societies that have any interest in what comes out of our Federal censuses, get busy as soon as possible and make a study of what the Federal enumeration might produce that would be of real practical value in our various lines of work, and get this before the Federal government and persuade the officials in charge that they ought to try to cover those things. Even if the 1920 census made some efforts along certain lines that are new but important and partly failed, it would really mean progress, because, as I say, if you look at the Federal censuses along back you will be impressed—at least, that is my very strong impression over and over again when I go there to get something—that we have up until now been getting very much what we got twenty or thirty years ago. We know a lot more about what we ought to have to-day than we did twenty or thirty years ago, and as a statistician I am impressed more and more with the fact that our real problems are problems of getting the original material rather than methods of handling afterwards. We know a great deal more about technical statistical methods than we did. We are much further along on that side of the matter than we are in the collection of adequate, accurate material. And as I said a moment ago, if we are going to have the material on a national

basis the most important agency for getting that is the Federal census.

I would like to see this organization some way or other get in line with these other organizations, and let us all put all the pressure we can on the Federal census officials to strike out on some new lines, try to get some things that we need, things we ought to have and that we need very badly. I am sure that unless we all do it, unless everybody who is interested, who has to go to the census reports for material to use practically, unless we all bring all the pressure we can to bear we are likely to get a repetition of the earlier censuses with very little change.

To mention two particular subjects in which I am particularly interested, I would like to see the statistics for manufacturing, or for industries, classified a little differently from the old classifications that have been followed for some time. I am not at all sure that it would not be possible, for example, for this Society to get such a classification of manufacturing industries used as would be comparable with the grouping of the manual classifications which have been set up in conference to use in connection with compensation work. Then I would like to see the census occupation figures better done. The 1910 census did something along that line which had not been done before. It did a good deal more and did it a good deal better in 1910 than was ever done before. The great trouble with the work then done was that the results were published so late that the figures were pretty nearly out of date by the time we got them. Figures as to the occupations of the population of the United States are of tremendous importance in all sorts of relations, and yet we have not got any very good occupation figures to-day. The matter of sickness insurance, the whole matter of occupational diseases, morbidity statistics and vital statistics, all require statistics of occupation for a great many studies. More and more the relation of a man's occupation to his health condition as well as social condition is being recognized. Now if we did not do any more, if all these societies together accomplished no more, than to improve occupation statistics over those that were gotten in 1910 and get them published reasonably promptly after the 1920 census is taken, we should have accomplished something well worth while. It would be worth a whole lot of effort to get that done. Those are two items, the matter of classification of industries and the occupation figures, that occur to me as matters that this organization would be interested in. There are a great many others, as Mr. Kopf has suggested.

I am sure—I have seen some of the efforts that have been made in connection with previous censuses—that it needs all the pressure of the opinion of experts in various lines, and particularly organizations composed of experts, it needs all the pressure possible to improve our census figures, and as I have said twice, unless we get them through the Federal census a great many things we are not going to get at all.

MR. GEORGE D. MOORE: Mr. Hatch has just stated that he would like to hear a discussion of the various problems that actuaries and statisticians meet in connection with their work under workmen's compensation. In answer, I would like to point out a few of the difficulties encountered. At the present time it is extremely difficult to obtain adequate and accurate scales of wages by states giving the number of workmen according to the size of wage received. This information is essential in the valuation of new compensation acts for rate-making purposes, or in the valuation of amendments to old acts. The state industrial accident boards and commissions do not appear to realize the importance of this information and the data obtained from reports, with the possible exception of Massachusetts and California, is inadequate and unreliable.

With regard to the reliability of the data in these reports, some time since, after carefully reading a report furnished by the industrial board of a middle western state, I concluded that a certain table of the distribution of accidents according to the period of disability was not complete, in fact it did not contain the most serious cases. I thereupon wrote a letter to the statistician of the board and received the astonishing reply that the table in question had not contained the pending cases because of the lack of appropriation made by the legislature for the use of that department. The publication of statistical tables in this manner should not be countenanced, as erroneous conclusions are frequently drawn from the information supplied and it oftentimes results in endless confusion.

The system in use at the present time of compiling wage statistics by the Census Bureau does not enable the statistician or the actuary to use the data for the purposes of valuing workmen's compensation benefits. What we need particularly is a distribution according to industries, as appearing in the Workmen's Compensation Manual Classification Code, or at least by a broader distribution according to the schedules appearing therein.

This need for compensation statistics should be strongly impressed upon the Census Department through the committee of this Society that has been appointed.

MR. E. H. DOWNEY: Mr. Chairman, there is one line of investigation which I think is extremely important, which hitherto has received very little attention in this country—I recognize it is a very difficult problem—namely, the age of superannuation in industry. An investigation by occupations with the present occupational classification of the census would probably not be very valuable, because of the small numbers in the ultimate groups. Probably the broader industry groups, even the industry classification that the census has hitherto used, would be better than an occupational division. The importance of the subject is primarily with reference to old-age relief, for the need of old-age relief, and the cost of old-age relief, will both depend upon the age at which wage workers cease

to be employed. Now, we know very little about this age of superannuation at the present time. We know very little about the expectancy of working life as contrasted with the expectancy of natural life. We all know in a general way that there are comparatively few men able to support themselves as wage earners beyond the age of 60. We know that the number diminishes from 50 onwards. But we know very little about the average age at which gainful employment ceases. We know very little about the working life expectancy. We know very little about the number of wage workers at ages from 50 to 65. We know very little about their earnings as compared with the earnings of wage workers at earlier groups. That is the information which is the foundation of any attempt to provide old-age relief in a systematic or in a scientific way. It is the fundamental information required for computing the cost of any old-age relief. And since that is a problem which I believe is coming rapidly to the front, will soon be a practical problem to be solved in this country, it seems to me that if the census can be made to throw light upon that problem, as I believe it can, it is a problem which should receive serious consideration.

I recognize that it is not sufficient simply to ask the census people to give us that sort of information. It is one of those problems in which the technical manner of compiling the information is the vital feature of the whole thing. It would be necessary to suggest to the pension authorities not only the need of investigating the problem, but the method by which it could be investigated. This matter has recently been brought to my attention in an entirely different connection, in connection with an attempt to establish disability ratings, the weights to be assigned to deaths and permanent disabilities with a measurement of severity of injury. Obviously a man who is permanently disabled has lost a working life expectancy. The severity of that accident is to be measured in terms of working life expectancy, which at present is X.

NOTE ON THE FREQUENCY CURVES OF BASIC PURE PREMIUMS.

BY

ARNE FISHER.

INTRODUCTORY REMARKS.

The question of a proper method of computing basic pure premiums in workmen's compensation insurance is of prime importance to all casualty statisticians and actuaries and can in no way be said to be finally solved. In the last number of this publication I gave a brief outline of a method for collecting data to be used in the calculation of pure premiums. This method, which was based on the theory of dispersion or stability of statistical series, was an attempt to determine the occupational hazard of the individual employee rather than the hazard according to industries. Mr. Mowbray had previously attacked the problem from the standpoint of frequency curves. He made the following statement: "I think we may properly consider the pure premium as made up of several elements, each having an independent probability of its own and each of which may therefore be properly considered, for purposes of discussion, alone and apart from the others and the results appropriately combined." This amounts practically to the system, originally developed by the great Laplace, for the deduction of the equation of a frequency curve. Laplace considers namely the frequency curve, $F(x)$, to have originated as the sum of a number of subsidiary frequency curves of the form $f_k(x)$ $(k=1, 2, 3, \cdots)$. It is, however, only in the statement of the origin of the final curve that Mr. Mowbray follows Laplace. Mr. Mowbray throughout the remaining part of his paper falls back upon the Gaussian Normal Curve, which is a particular case of the general Laplacean frequency curve. In a later discussion of Mr. Mowbray's article I pointed out the fact that in most cases we were not justified in regarding the frequency distribution as a normal one as we actually were dealing with a decidedly skew curve of the Charlier B Type.

In this paper I shall make an attempt to give a fuller discussion of such skew curves as are derived from the data given by the

recently published experience by the Norwegian Government, viz.: "Ulykkesforsikringen for Industriarbejdere," Christiania, 1915. (Accident Assurance for Industrial Workers.) This experience covers the period from 1895 to 1912, and includes 172 groups of industries with a total payroll of 1,835,632,504 Kroner and a total loss of 31,464,034 Kroner in the above mentioned period, or a pure premium of 17.1‰* of the total payroll for all industries.

The accident and invalidity insurance as practised by the Norwegian Government Institution is founded upon actuarial principles somewhat similar to those adopted by the various American companies. The losses are based upon the commuted (capitalized) values of the future benefit contingencies at the time of the accident. The actuarial tables, select as well as truncated mortality and invalidity tables for both sexes, are derived from Norwegian census data and represent without doubt the most scientifically constructed tables, which we possess at the present time. In choosing a rating system the Norwegians have wisely decided to use the level rate system instead of the assessment system. Personally, I consider this method as far superior to that of levying an assessment each year for an amount sufficient to cover the capitalized (commuted) losses incurred during the year. A certain year may be very favorable and exhibit only a few fatalities and accidents to be followed sooner or later by a very unfavorable year with great losses, and perhaps the very unfavorable experience may occur at a time of economic depression in which the financial conditions of the industries are such that they are little adapted to carry the additional burden. As an example of the great deviations I choose the following figures from the cooperage trade in the period 1909–1912.

COOPERAGE INDUSTRIES (1909–1912).

Year.	Salaries in Kroner.	Losses in Kroner.	Rate ‰.
1909	295,402	3,562	12.1
1910	377,483	6,123	16.2
1911	367,044	17,839	48.6
1912	189,738	223	1.2

THE QUESTION OF STABILITY.

One of the first steps in a statistical analysis is to test the stability of the series as exhibited by the actually observed data. Does the

* Expressed in terms of mills, not of per cent.—a notation used throughout this paper.

ratio of the losses to the payrolls show violent fluctuations from year to year, and is it possible to trace such fluctuations to their proper sources? I have repeatedly maintained that statistical frequency ratios are not identical with mathematical probabilities, and that it is necessary to test the stability of the observed data before using such data for future predictions. It does not suffice to rely upon the idea that a rate is safe if the number of observations is large enough. In order to determine whether the industrial conditions in Norway are such that they may be considered stable from year to year, I give below a detailed computation of the Charlier coefficient of disturbancy, which is one of the best criterions in the test for stability.

LOSSES AND CORRESPONDING PAYROLLS BY CALENDAR YEARS FROM 1895–1912. ALL INDUSTRIES. (RIKSFORSIKRINGSANSTALTEN, 1915 REPORT.)

Year.	Payroll in 1,000 Kroner, s_κ.	Losses in 1,000 Kroner, m_κ.	$s_\kappa p_0$.	$\lvert m_\kappa - s_\kappa p_0 \rvert$.
1895/96	96,042	1,817	1,646	171
97	70,656	1,357	1,211	146
98	81,595	1,582	1,398	184
99	92,393	1,635	1,584	51
1900	93,518	1,710	1,603	107
01	94,037	1,626	1,612	14
02	92,894	1,453	1,592	139
03	91,529	1,568	1,568	0
04	91,760	1,464	1,573	109
1905	94,103	1,480	1,613	133
06	103,154	1,679	1,768	89
07	114,517	1,982	1,973	11
08	122,147	1,904	2,093	189
09	133,208	2,095	2,283	188
1910	140,938	2,416	2,416	0
11	153,224	2,872	2,626	246
1912	169,918	2,821	2,912	91
Totals	1,835,633	31,461		1,868

$\delta = 1.0176$, $\sigma = 1.2533$, $\delta = 1.2754$, $\sigma_B^2 = 1.5601$,

$$\rho = \frac{\sqrt{1.6266 - 1.5601}}{17.1} = .0015.*$$

The above calculation shows that the Charlier coefficient of disturbancy, 100ρ, has the low value of 0.15, which clearly indicates that for all practical purposes we may safely consider the annual total losses as a normal and stable statistical series, wherein the

* See Fisher: "Mathematical Theory of Probabilities," p. 160.

perturbations are due to sampling only. This goes to show that in Norway, at least, the various industries have reached a state of stability so far as accidents are concerned. This probably is due to factory inspection and a rigid enforcement of factory laws requiring the installation of various safety devices. Whether the same stable conditions exist in America can only be determined by actually computing the coefficient of disturbancy for a loss series corresponding to the one given above for Norway.

The Classification of Risks.

The Norwegian system of classifying risks bases the pure premium according to industries. At the time of the establishment of the Government Assurance Institution (1895) no data as derived from purely Norwegian experience were at hand, and the founders of the institution fell back upon the German system of grouping the various trades in 6 danger classes with following premium rates.

Danger Class.	Rate per 1000 of Payroll
1	5
2	7
3	11
4	15
5	20
6	25

This grouping was already in 1899 increased to 16 danger classes with following rates:

Danger Class.	Rate per 1000 of Payroll.
4	4
5	6
6	8
7	10
8	12
9	14
10	16
11	18
12	20
13	24
14	28
15	32
16	36

As the business and experience expanded additional danger classes were incorporated so that in the 1915 report we have no less than 24 classes distributed as follows:

Danger Class.	Rate per 1000 of Payroll.
3	2
4	4
5	6
6	8
7	10
8	11
9	12
10	13
11	14
12	16
13	18
14	20
15	22
16	25
17	28
18	30
19	32
20	36
21	40
22	45
23	50
24	60

The advantage of a limited system of danger classes as described above is twofold. It gives first of all a comparatively small number of pure premium rates upon which the final gross office rates of the tariff may be based. Secondly, a limited classification enables us to collect sufficient statistical data from which empirical pure premiums may be constructed.

The question which is of great importance is to what extent the various danger classes are subject to fluctuations. Each danger class may be looked upon as a sum total of several sub-classes, each subsidiary danger class possessing its own particular frequency curve. The individual frequency curves inside a certain danger class will together form a Lexian Series, that is a set of sample sets with varying probability from set to set. If we for practical purposes are justified in regarding each sub-group as a Bernoullian Series, the danger class may be represented as Lexian Series whose frequency curve will be either an A or a B curve.

For the purpose of computing the parameters of the various frequency curves I have chosen a slightly different classification than the one used in the Norwegian Manual. The less dangerous traces I have grouped in 6 danger classes and fitted to B curves of the form: $F(x) = \psi_\nu(x) + \gamma_2 \Delta^2 \psi_\lambda(x)$ where $\psi_\lambda(x)$ is the Poisson exponential, λ and γ_2 certain parameters. In a later paper I intend to deal with the A curves of the remaining danger classes.

The following tables give the various danger classes with their subgroups and B curves.

DANGER CLASS NO. 2 (FROM 2 °/₀₀–4 °/₀₀).

Industry.	Losses.	Payroll.	Rate °/₀₀.
Faience factories	7,276	3,825,315	2.2
Manufacture of Paris points	3,424	1,542,083	2.2
Porcelain works	6,783	2,963,836	2.3
Tobacco works	35,877	15,687,525	2.3
Book printing and lithography	79,115	35,056,063	2.3
Caoutchouc works	4,207	1,535,502	2.7
Gold and silver smiths	22,005	7,545,443	2.9
Cotton spinneries (small works)	1,841	567,377	3.1
Chocolate and candy works	15,891	4,824,228	3.3
Cotton and woolen weavers	13,698	3,483,822	3.6
Ribbon weavers	7,962	2,038,748	3.9

Fitting the above data to a Poisson-Charlier B Curve, we have: $\lambda = 2.8$, $\gamma_2 = 0.127$ and $F(x) = \psi_{2.8}(x) + 0.127\Delta^2\psi_{2.8}(x)$, resulting in following values:

x	$F(x)$
0	.0685
1	.1764
2	.2331
3	.2119
4	.1493
5	.0870
6	.0435
7	.0191
8	.0074
9	.0027
10	.0008
11	.0002
12	.0001

The number x denotes the loss per 1000 of salary and $F(x)$ the probability of the occurrence of such a loss. The accompanying figure 1, of the curve shows it is decidedly skew.

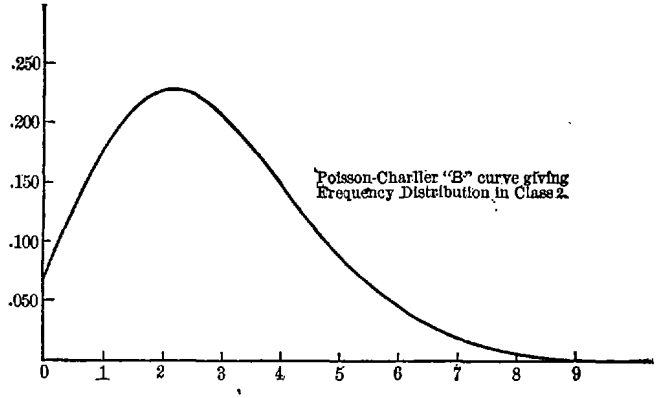


Figure 1.

DANGER CLASS NO. 3 (FROM 4 °/₀₀–6 °/₀₀).

Industry.	Losses.	Payroll.	Rate °/₀₀.
Knitting works	10,932	2,758,529	4.0
Brush factories	5,788	1,361,198	4.2
Shoe factories	71,241	16,636,010	4.3
Glass works	64,013	14,679,270	4.4
Textile works	123,235	28,131,256	4.4
Book binding	16,785	3,633,445	4.6
Soap works (with motor)	5,734	1,217,803	4.7
Manufacture of gas and sewer mains	8,631	1,799,768	4.8
Manufacture of mats, hemp and jute	36,753	7,603,414	4.8
Tanneries	37,972	7,689,349	4.9
Manufacture of nails, screws, etc.	70,319	13,874,259	5.1
Manufacture of spices, coffee roasting, etc.	7,689	1,494,860	5.1
Metal works (brass foundry)	15,308	2,924,874	5.2
Match factories	51,436	9,781,926	5.2
Frame and panel works	7,107	1,310,020	5.4
Work under the navy	87,925	16,281,365	5.4
Bakeries and confectioners	120,794	21,566,643	5.6

The parameters as fitted to a B curve are: $\lambda = 4.8$, $\gamma_2 = 0.085$ and $F(x) = \psi_{4.8}(x) + 0.085\Delta^2\psi_{4.8}(x)$. See Figure 2.

x	$F(x)$
0	.008930
1	.041462
2	.096849
3	.151825
4	.179773
5	.171550
6	.137446
7	.095098
8	.057992
9	.031654
10	.015650
11	.007050
12	.002948
13	.001139
14	.000138
over 15	.000496

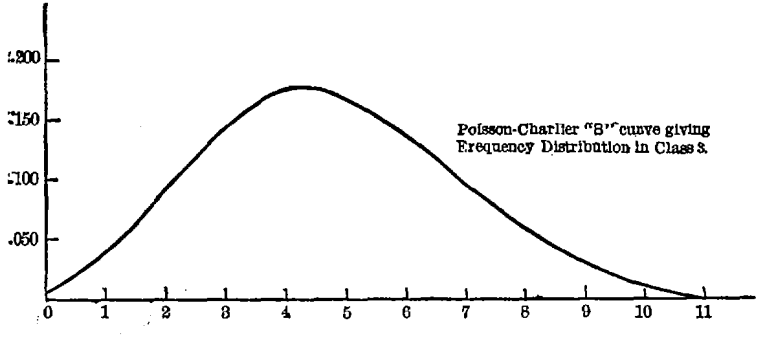


Figure 2.

DANGER CLASS NO. 4 (FROM 6 °/₀₀–8 °/₀₀).

Industry.	Losses.	Payroll.	Rate °/₀₀.
Woolen weavers	12,769	2,075,216	6.1
Condensed milk works	34,998	5,603,452	6.2
Piano works (with motor)	13,436	2,143,135	6.3
Oleomargarine works	38,982	5,927,310	6.6
Installation of small electric works	25,812	3,748,121	6.9
Manufacture of fishing net	10,617	1,542,953	6.9
Railway wagon works	42,692	6,041,482	7.1
Soap and perfume works	5,717	800,242	7.1
Works, under Army	114,942	15,907,629	7.2
Potteries	8,494	1,159,214	7.3
General woolen works	183,061	25,201,093	7.3
Dairies	77,472	10,412,116	7.4
Small mechanical shops	22,519	2,938,184	7.7
Hemp, jute and linen spinneries	53,001	6,873,647	7.7

Parameters as fitted to a B curve are: $\lambda = 7.0$, $\gamma_2 = 0.234$. Hence we have:

x	$F(x)$
0	.0012
1	.0075
2	.0248
3	.0554
4	.1006
5	.1271
6	.1455
7	.1440
8	.1258
9	.0930
10	.0695
11	.0462
12	.0280
13	.0158
14	.0083
15	.0041
16	.0019
17	.0008
18 and over	.0005

The curve is shown in Figure 3.

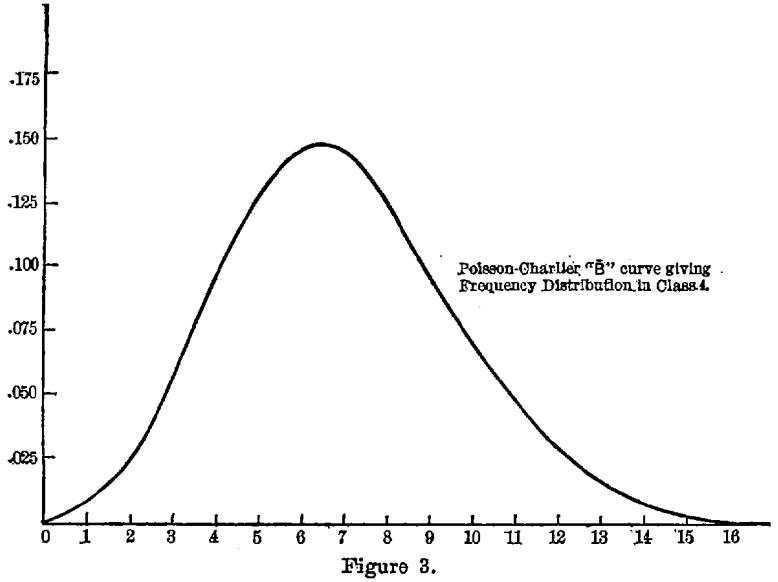


Figure 3.

DANGER CLASS NO. 5 (FROM 8 °/₀₀–10 °/₀₀).

Industry.	Losses.	Payroll.	Rate °/₀₀.
Street car service outside power house.	99,679	10,474,345	9.5
Work in store house, loading and unloading of ships	408,307	41,309,317	9.9
Brickyards	61,891	6,781,763	8.4
Iron and steel foundry without model shops	144,584	16,431,262	8.8
Manufacture of tools and cutlery	15,151	1,599,854	9.5
Woolen spinneries	15,087	1,782,739	9.6
Dye works (with motor and stamping)	21,151	3,323,405	9.1
Manufacture of paper and paste board	16,882	2,046,040	8.2
Conserves manufacture (without box making)	19,495	2,288,443	8.5
Conserves manufacture (with box making)	155,984	19,376,285	8.1
Butcheries, sausage works with motor.	53,270	6,361,006	8.4

The parameters are here: $\lambda = 8.9$, $\gamma_2 = 0.27$. See Figure 4.

x	$F(x)$
0	.0002
1	.0015
2	.0063
3	.0178
4	.0381
5	.0657
6	.0949
7	.1183
8	.1299
9	.1276
10	.1136
11	.0926
12	.0698
13	.0488
14	.0319
15	.0195
16	.0113
17	.0062
18	.0032
19	.0016
20 and over	.0012

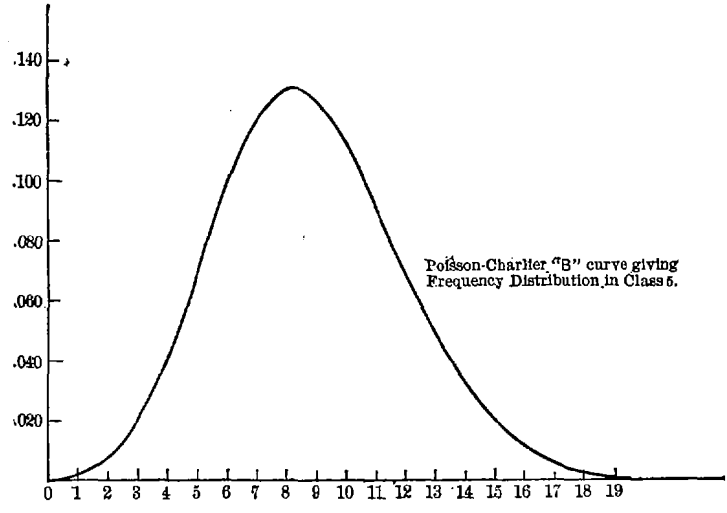


Figure 4.

DANGER CLASS NO. 6 (FROM 11 °/₀₀–14 °/₀₀).

Industry.	Losses.	Payroll.	Rate °/₀₀.
Railroading	143,453	12,513,539	11.5
Storage work (exclusive of ship transport)	250,345	19,306,977	13.0
Storage work (connected with ship transport)	30,060	1,880,778	13.5
Iron works (furnaces)	15,840	1,542,062	10.3
Steel works (rolling)	9,980	890,013	11.2
Mechanical shops	787,088	67,377,472	11.7
Wagon factories (with motor)	24,127	2,049,263	11.8
Manufacture of electric light and power supplies	88,598	8,016,661	11.1
Electro-chemical works	43,984	3,497,863	12.6
Paper and carton works	454,293	39,619,658	11.5
Saw mills (Group I)	1,429,922	106,474,329	13.4
Planing mills	190,703	14,507,952	13.1
Mills (flour, groats, etc.)	262,540	19,052,627	13.8
Distilleries	35,240	2,473,218	13.5
Breweries	342,795	28,704,711	11.9
Painter (building trade)	196,578	16,748,653	11.7
Gas, water and sewer works	87,135	6,383,275	13.7
Installation of telegraph and telephone lines	70,457	5,476,201	12.9
Chimney sweeps	15,068	1,410,373	10.7
Government works	33,919	2,687,056	12.6

A computation of the parameters gives: $\lambda = 12.3$, $\gamma_2 = 1.04$ and the following values for $F(x)$. See Figure 5.

x	$F(x)$
0	.0000
1	.0001
2	.0007
3	.0022
4	.0062
5	.0141
6	.0268
7	.0438
8	.0632
9	.0818
10	.0963
11	.1043
12	.1050
13	.0989
14	.0878
15	.0737
16	.0589
17	.0446
18	.0323
19	.0224
20	.0148
21	.0094
22	.0057
23	.0033
24	.0018
25	.0010
26	.0005
27	.0003
28	.0005

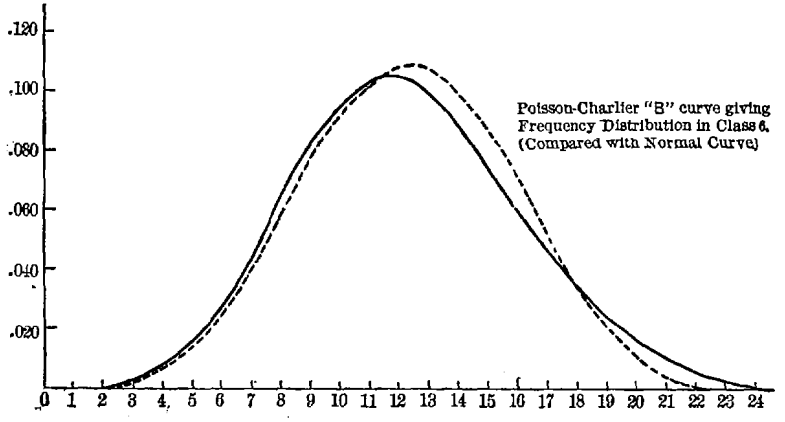


Figure 5.

Comparison of Expected and Actual Losses.

The equations of the above frequency curves are derived by giving equal weight to the various sub-classifications. This is, strictly speaking, not exact when the payrolls differ greatly, since we in such cases give equal weight to small and large payrolls. Introduction of weighted systems would indeed offer no serious obstacles. It may, however, be of interest to compare the expected losses as derived from the equations of the frequency curves as based upon the unweighted data with the actual losses incurred in the 17-year interval.* The losses in each danger class may be looked upon as a mathematical expectation. "A mathematical expectation is the product of an contingent gain (loss) in actual value and the mathematical probability of obtaining such a gain (loss)."†

The computed values of $F(x)$ for each danger class as given above makes the calculation of the expected losses quite simple. Take for instance danger class No. 2. The probability of the occurrence of a loss of $1.00 per 1000 of payroll is 0.1764, that of a loss of $2.00 is 0.2331, that of $3.00 is 0.2119, and so forth. The total expected loss per 1000 of payroll is therefore:

$$E = \Sigma x F(x) = 0 \times .0685 + 1 \times .1764 + 2 \times .2331 + \cdots + 12 \times .0001.$$

Multiplying this with the sum total of the payroll, we obtain the total expected losses or $P \times E$, where P is the total payroll.

An actual calculation for the various danger classes gives the following results:

Danger Class.	Sum Total of Payrolls.	Expected Losses Computed from B Curves.	Actual Losses.	Excess (+) or Deficient (—).	Per Cent. of Actual Loss.
2	78,070,000	218,603	198,079	+ 20,524	10.36
3	131,176,000	629,290	620,850	+ 8,440	1.36
4	90,373,000	629,077	644,422	− 15,345	2.37
5	111,773,000	994,489	1,011,481	− 16,992	1.67
6	360,613,000	4,387,494	4,492,125	−104,631	2.33
All classes	772,005,000	6,858,953	6,966,957	−118,004	1.69

The deficiency for all classes is 1.69 per cent. of the total losses,

* In this connection see the remarks by Mr. Joseph H. Woodward on page 478 of Volume II of the *Proceedings*.

† Fisher, "Mathematical Theory of Probabilities," page 49.

which is a rather close fit despite the fact that an unweighted series was used in the determination of the parameters. The various curves seem therefore safe approximations for the pure premiums, which with proper loadings ought to serve quite satisfactory as a basis for office rates. The curves show how important an element is the fluctuations due to random sampling. Take for instance danger class No. 5. The probability that the loss will be less than $5.00 is .0637, but the probability it will be $11.00 or more per 1000 is .2861, or we might expect that in 286 out of 1000 cases the loss will be higher than 11 dollars per 1000 of payroll.

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

A SUGGESTION FOR A MODIFIED FORM OF AMORTIZATION, WITH A BRIEF MEMORANDUM OF THE APPLICABILITY OF THAT PRINCIPLE TO THE BONDS OF MISCELLANEOUS COMPANIES—S. HERBERT WOLFE.

VOL. III, PAGE 4.

WRITTEN DISCUSSION.

MR. WILLIAM BREIBY:

Mr. Wolfe in his paper attacks the present system of amortizing bonds, because, he says it "is based upon hypotheses which never exist and in consequence produce theoretical results only," and also hints that the work involved in using that method is unduly complicated. He then proposes as a substitute, amortization as if all bonds were purchased to yield the same rate of interest.

He says further, in the first paragraph following his Table III, that, in order to extinguish the premiums scientifically according to the effective rate corresponding to the purchase price, the amounts he shows in column (3), Table III, called the "Amortization Factor" (which is, of course, the amortization factor applying in the first period only), "must be reinvested the instant . . . received, and the amount . . . must be used to purchase securities which will yield its effective rate shown in column (4)."

This statement, I believe, can be shown to be wrong. The successive "Amortization Factors," where a bond is bought at a premium, are actual repayments of principal, and we are not concerned with the rate, or time, at which they are re-invested, so far as affecting the yield on, or values of, the particular block of funds originally invested and the successive balances of principal outstanding. Though this is seen by the usual text-book analysis of the annuity certain in the formula:

$$k = (g - i)\,a_{\overline{n}|},$$

where k is the rate of premium or discount, g, the rate of "coupon," i, the rate of effective interest yield, and $a_{\overline{n}|}$ is calculated at rate i, a schedule showing the actual figures may better help to refresh the

memories of those who have not for some time past looked at a text-book on "Interest and Annuities Certain":

TABLE *A*.

BOND OF $1,000,000.00 PAR, PAYING 2½% ($25,000) SEMI-ANNUALLY, MATURING AT END OF FIVE YEARS. TO YIELD 2¼% SEMI-ANNUALLY, I. E., YIELDING ¼% LESS EACH PERIOD THAN THE RATE OF COUPON.

Amortized Value $= (v^n + .025 \cdot a_{\overline{n}|}) \times 1{,}000{,}000$, v^n and $a_{\overline{n}|}$ Calculated at Rate .0225.

Half-year Periods n.	(1) Amortized Value or Principal Outstanding.	(2) Semi-annual Interest on Outstanding Principal (1) × .0225.	(3) Semi-annual Amortization Item or Repayment of Principal $25,000—(2).
10	$1,022,165.54	$22,998.725	$2,001.275
9	1,020,164.27	22,953.696	2,046.304
8	1,018,117.97	22,907.654	2,092.346
7	1,016,025.62	22,860.576	2,139.424
6	1,013,886.19	22,812.439	2,187.561
5	1,011,698.63	22,763.219	2,236.781
4	1,009,461.86	22,712.892	2,287.108
3	1,007,174.74	22,661.432	2,338.568
2	1,004,836.18	22,608.814	2,391.186
1	1,002,444.99	22,555.012	2,444.988
0	1,000,000.00	.....	.....

Sum of principal repayments	$ 22,165.541
Cost price of bonds	1,022,165.54
Balance = redemption value	$1,000,000.00

Of course, the sum of column (3) equals the premium on the bond, so, as the schedule clearly shows, in each of the $25,000 of coupons as paid is included the repayment of principal of the successive amounts shown in (4). It need hardly be said that, after determining the yield, the schedule could be prepared without previously calculating the whole of column (1), by the operations indicated at the head of columns (2) and (3) and successive subtraction of the figures in (3) from those in (1).

In text-books and discussions on amortization the case of bonds bought below par is often discharged with the statement that the rules are similar to those applying to bonds bought at a premium, but as the operations and the results are rather reversed, I give here a schedule showing the figures for a bond bought at a discount.

Here, of course, the "Extra Interest" is that portion of the difference between the amount payable at maturity and the cost price which can be considered as having accrued for the interval indicated. There is no need to re-invest any sum during this period at any rate in order to carry out the system of amortization. The $20,000 is received each period, together with the certain ac-

crual of value to the purchase cost. There can be no question that at the maturity there will have been received $20,000 at the end of each period, and a lump sum at maturity, such that the yield will have been semi-annually 2¼ per cent. on the original cost and outstanding principal amounts.

TABLE *B*.

BOND OF $1,000,000.00 PAR, PAYING 2% ($20,000) SEMI-ANNUALLY, MATURING AT END OF FIVE YEARS. TO YIELD 2¼% SEMI-ANNUALLY I. E., YIELDING ¼% MORE EACH PERIOD THAN THE RATE OF COUPON.

Amortized Value $= (v^n + .02 \cdot a_{\overline{n}|}) \times 1{,}000{,}000$ or $(1 - .0025 \cdot a_{\overline{n}|}) \times 1{,}000{,}000$.

Half-year Periods n.	(1) Amortized Value or Principal Outstanding.	(2) Semi-annual Interest on Outstanding Principal (1) × .0225.	(3) Semi-annual Amortization Item or Extra Interest, being Accrual of Principal (2)—$20,000.
10	$ 977,834.46	$22,001.275	$2,001.275
9	979,835.73	22,046.304	2,046.304
8	981,882.04	22,092.346	2,092.346
7	983,974.38	22,139.424	2,139.424
6	986,113.81	22,187.561	2,187.561
5	988,301.37	22,236.781	2,236.781
4	990,538.15	22,287.108	2,287.108
3	992,825.26	22,338.568	2,338.568
2	995,163.83	22,391.186	2,391.186
1	997,555.01	22,444.988	2,444.988
0	1,000,000.00	.....	.....

Sum of accruals of principal	$ 22,165.541
Cost price of bonds	977,834.46
Sum = redemption value	$1,000,000.00

As in the first table the columns (2) and (3) could, of course, have been developed without the preliminary calculation of all the values in (1), by adding the successive values in (3) to those in (1). The sum of (3) of course equals the discount at which the bond was bought. As in this case we have a bond with a "coupon" rate ¼ per cent. more than the yield, the discount equals the premium in Table *A*, where the yield exceeded the "coupon" rate by ¼ per cent. The formula demonstrating this fact being the same as before quoted: $k = (g - i)a_{\overline{n}|}$, k being rate of premium, or discount: in one case being plus, and in the other minus.

Thus, I do not see how the principle underlying the present method of amortization of bonds fails to apply to actual conditions existing, nor how it produces theoretical results only.

In case it were necessary that the outstanding principal should remain throughout at the original investment, and the amount earned thereon periodically should be at that effective rate of yield,

Mr. Wolfe's statement, that the amortization factor must be reinvested the instant received, is correct when extended to include the continued reinvestment of the "amortization" elements. If it were, however, required to have on hand at the maturity of the bond the exact amount originally invested, together with interest compounded thereon at the effective rate of yield, it would be necessary to reinvest immediately the total of each coupon payment at the same effective rate. This is of course readily seen by the equality

$$(v^n + g\bar{a}_{\overline{n}|})(1+i)^n = 1 + g\bar{s}_{\overline{n}|}.$$

For life insurance the net premiums are calculated on the assumption that they are invested at compound interest as soon as collected, and accumulated in that way to the maturity of the insurances. So that an insurance company operating under such an assumption must avoid investing too large a proportion of its funds in securities bought at a premium with an interest yield just in excess of that assumed in the premium calculations, unless, of course, there were assurance that the principal repayments could be reinvested to yield at least the assumed rate. Where, however, assuming the security behind the bonds is ample, bonds are bought at a discount, such possible difficulty is not presented. On the other hand, in such a company insurances are constantly maturing, and theoretically the company needs constant repayment of some of the principal.

As to the work involved in deriving the amortized values under the present method:

First it is necessary to ascertain the interest yield, which is usually established to the nearest 1/100 per cent. by proportion between the tabular values, as given in a bond value table or book, for the usual rates of yield at intervals of 5/100 per cent. By observing the differences between values at the successive rates it can readily be seen that the yield so obtained is as correct as needed, and probably seldom differs in the second place of decimals per cent. from that derived by formula.

After so determining the yield the amortized values corresponding to that rate are derived by proportion between the tabular values. Even if the established rate should be wrong by as much as 1/100 per cent., the values so derived are sufficiently accurate and average with others, and as the period to maturity reduces, the values so derived approach absolute accuracy. The difference between values at different rates approaches nr as n becomes small, where r is the difference in rates and n the number of periods.

Where bonds are bought on dates other than interest due dates, values are interpolated between the tabular values by proportion to correspond to such time, and then the rate of yield is determined from such interpolated values as above described. Similarly the December 31st values are established by proportion between the

tabular. Values for dates other than interest due dates so obtained give correct results on the assumption of simple interest within an interest period.

Where later purchases are made of the same issue of bonds already held, the usual practice is to add the purchase price of the new lot to the amortized value of the old lot brought down to date of new purchase, or else to bring them both down according to their respective yields to some common date, such as December 31st, and then ascertain a new yield based on the sum.

All of this work requires only a knowledge of arithmetic, and instructions can easily be given to clerks to carry out the work. Where the records are kept on cards, and the values entered from year to year, as is usual where many bond transactions take place, the cards could readily be sorted so that the bond value book could be used to best advantage with a minimum turning of pages.

Where bonds are bought to yield a rate beyond published tables a knowledge of the algebra of bond calculations is, of course, required, but the increased yield would well compensate for the increased cost of calculation, and if opportunity to invest at such high rates should prevail for any time published tables would soon be extended to include them.

To ascertain the actual interest earned during the year the items of "interest received" must be modified by the amortization items, as shown in the Gain and Loss Exhibits of most of the New York life insurance companies.

Whether the bond values entered in the periodic statements of a company are the amortized values or not, the company's official in charge of investments should have on hand schedules showing the amortized values, in order to determine readily whether at any time it is advantageous to sell the securities. The fact that where securities are sold causes a yield to have been experienced different from that where held until maturity, does not vitiate the principle of amortization; because the profit or loss on sale would be a distinct profit or loss as compared with the then amortized value, which is really the cost price extended to the time of sale. The bookkeeping in case of a sale could be carried out by extending the amortized value from the last statement date to date of sale, entering the difference in either "Increase for accrual of discount," or "Decrease for amortization of premiums," as the case may be, and then entering the difference between that amortized value and the selling price in either "profit (or loss) on sale of bonds"; or else by entering the difference between the selling price and the amortized value at the last statement date in "profit (or loss) on sale of bonds."

As to Mr. Wolfe's proposed method. If all the bonds were bought to yield approximately the same rate, amortization by using annuities certain based on a single rate of interest would probably be

sufficiently accurate for statement purposes. But without the amortized values for particular bonds there would not be the means to learn readily whether it were advantageous to sell as changes took place in the market values. As a matter of fact the yields on the different lots of bonds are spread over quite a range, as Mr. Wolfe indicates in referring to bonds yielding rates beyond present practical bond value tables, and amortization by means of annuities certain based on the average rate earned on all would probably seldom give results approaching a correct amortization.

The use of a single rate table would give results which would not alow of any valuable interpretation or analysis, and there could not be ascertained therefrom the actual interest earned in a year as outlined above. Further, when it was found that a change in the assumed interest rate would have to be made, the change in the aggregate bond values in that year would be violent, though the change in conditions had probably been gradual; and I fail to see how such a system would be better than one of market values, or of carrying the bonds at cost price until maturity.

Following Table I, Mr. Wolfe points out that the amorization of bonds is complicated because bonds are not always bought on coupon dates. The same complication arises also under the proposed plan. His table gives the annuity amounts for periods which are likewise multiples of 6 months, and values would have to be gotten up for all intervening times, and some adjustment would have to be made to get December 31 values. As soon as the values in the single table cannot be used directly most of the advantage claimed for the proposed system disappears. Further, as bonds are bought on different dates, and with various maturity and interest dates, they could not readily be grouped so as to have one factor apply to a group comprising several lots.

In the third paragraph under Table III he says, "why not adopt some method . . . which permits the use of a standard table . . . dealing only with the purchase prices."

In applying the table of annuities certain to the first case given above, the work would be as follows:

Premium to be extinguished		$22,165.54
Dividing that by the amount opposite 5 in Mr. Wolfe's Table IV of annuities certain	$11.075,708	
Gives what would be his first amortization factor for the case...		2,001.28
Balance being the Premium Outstanding		20,164.26
Dividing that by the amount opposite 4½ in Table IV	$9.853,993 =	2,046.30
Leaving balance		$18,117.96
etc., etc., etc.,		

i. e., reproducing the values in column (3), and the premiums in column (1) in Table *A* above. Just how this proposed system deals

only with the purchase price any more than the usual amortization method it is hard to see.

As to extending the amortization plan to the so-called "miscellaneous" companies: Many of such companies, as going concerns, are probably not more subject to the need of disposing of large blocks of their assets than savings banks, and an amortization plan could probably be used. Where, however, owing to the nature of the business, a company is liable to an "underwriting loss" such as under Company *E* in Mr. Wolfe's Table VI, I do not think it advisable to permit the use of an amortization method. Where a company's status is subject to sudden change, dependent on immediate circumstances or conditions, its assets should be stated in any statement at values most likely to be realized immediately in case of necessity. It is conceivable that a company doing a business subject to violent loss, even though carrying multiple lines, could be so impaired as not to be in shape to reinsure.

Before permitting "miscellaneous" companies to amortize their bonds, it might be instructive to learn how far such companies have in the past found it necessary or desirable to sell some of their bonds because of the nature of their business.

Though I feel that in a discussion of this paper it is not necessary to raise the question of the relative merits of a market value method and an amortization method, I will venture to say in closing that the most valuable plan is that which best shows the going qualities of a company; and as market values are indicative more of the immediate time or recent past, whereas amortized values are of the nature of "going" values, the latter are the ones to use.

Note: Since writing the above I have read Mr. Alexander T. Maclean's criticism of Mr. Wolfe's paper as published in the *Economic World* of Dec. 2, 1916, and find his remarks to be along the same general lines as those in this discussion.

MR. VIRGIL M. KIME:

The method of valuation of the bonds of companies amortizing their bonds is, if purchased above or below par, on the basis of the purchase price, adjusted so as to bring the value to par at maturity, and so as to yield meantime the effective rate of interest at which the purchase was made.

When a bond is purchased at a premium, the application of the amortization principle consists in the application of a portion of each gross interest payment from the debtor corporation to the liquidation of the principal of the investment and a portion to the payment of interest on the unliquidated investment. The total investment decreases from interest period to interest period, the balance of principal at maturity being the amount then payable.

The following table illustrates the application of the principle to a $10,000 ten-year bond investment bearing 5 per cent. interest

purchased at a premium of $1,256.47 to yield 3½ per cent. interest on the investment.

$10,000—5 PER CENT PAYABLE SEMI-ANNUALLY 10 YEARS.
To Yield 3½ Per Cent. Payable Semi-annually.

Period.	Payment at End of Period.		Principal at End of Period.
0 Yr.	Interest	Principal	$11,256.47
.5	$196.98	$53.02	11,203.45
1.	196.06	53.94	11,149.51
1.5	195.12	54.88	11,094.63
2.	194.16	55.84	11,038.79
2.5	193.18	56.82	10,981.97
3.	192.18	57.82	10,924.15
3.5	191.17	58.83	10,865.32
4.	190.15	59.85	10,805.47
4.5	189.09	60.91	10,744.56
5.	188.03	61.97	10,682.59
5.5	186.95	63.05	10,619.54
6.	185.84	64.16	10,555.38
6.5	184.72	65.28	10,490.10
7.	183.57	66.43	10,423.67
7.5	182.42	67.58	10,356.09
8.	181.23	68.77	10,287.32
8.5	180.03	69.97	10,217.35
9.	178.80	71.20	10,146.15
9.5	177.56	72.44	10,073.71
10.	176.29	73.71	10,000.00

It will be noted that the interest is for each period 1¾ per cent. of the principal at the end of the preceding period.

The transaction consists in the investment at the beginning of the ten-year period of $11,256.47, in the reduction of the investment by a part payment thereof from half-year to half-year in the amount indicated in the table, and in the final payment of the balance of principal at the end of ten years of $10,000. I cannot see that the disposition to be made of any portion of the principal when it is repaid enters into the problem. A company might in a similar manner invest in farm mortgage security in the sum of $10,000 to bear at 5 per cent. per annum, payable semi-annually; $5,000 to mature in 2½ years and $5,000 to mature in 5 years. The yield on the investment would, it seems, be determined by the yield on $2,500 for 2½ years and for 5 years respectively. The manner in which the $2,500 repaid at the end of 2½ years is invested or disposed of would hardly affect the yield on the investment. Applying the same principle, the disposition of the series of principal repayments, $53.02, $53.94, etc., would not affect the yield of the investment, while invested in the bond.

If the problem be to invest $11,256.47 for ten years and to determine the yield on the full amount including the diminishing bond

principal half yearly amounts falling to be reinvested, we must then take into consideration the reinvestment rate, or as it is described in the *Text Book of The Institute of Actuaries, Part I,* the reproductive rate. The problem involved in amortization is, however, I believe, that of the determination of the yield under the investment while invested in the bond and not thereafter. If that be the case, the usual method of bond amortization seems the proper one to apply.

In the absence of statutory provision and where the bond investments are made at similar remunerative rates, Mr. Wolfe's suggestion of the use of one interest rate to be used in amortization could be applied at a considerable saving in labor. In fact, Mr. Joseph Burn, in his *Stock Exchange Investments,* suggests that all sinking funds be computed at some average rate of interest and that such average rate of interest be one which would result in a somewhat more stringent treatment, that is a more rapid reduction of principal, than would be shown by taking true rates for every individual investment.

When a bond is purchased below par, it would seem that the principal invested is as a matter of fact being accumulated at the rate of interest yielded by the bond investment, so that the question of the average rate yielded by a company on its investments would not enter.

We are indebted to Mr. Wolfe for a discussion of the application of a sinking fund method to the amortization of bond premium. Beyond question, I should agree with his method were the problem thereof determining the yearly interest yield on an invested fund to be held intact over a given period.

The Society should be very gratified to have printed in its *Proceedings* Mr. Wolfe's able discussion of the application of the amortization plan to "miscellaneous" companies. Where the catastrophe element is properly provided for, the investments of a "miscellaneous" company are in the nature of fixed assets to be held until maturity just as in the case of a life insurance company. A method of relieving such companies from the burdens incident to the taking into account of market value fluctuations is equitable and fair. The use of average market values spread over a period is not desirable because of fluctuations therein and because the method of valuation is one not intrinsically connected with the bond investment.

Even in cases of reinsurance, as pointed out by Mr. Wolfe, the company assuming the risks should be permitted to carry the assets of the ceding company at the investment value and should not be required to use market values as of the date of reinsurance. Market values would depend upon variations in the market altogether foreign to the intrinsic quality of the investment.

Oral Discussion.

Mr. Albert H. Mowbray: Mr. Chairman, one point has occurred to me. Mr. Wolfe proposes, as I understand it, to value the bonds at a uniform rate to be determined from a study of recent earnings. He says on page 7: "The plan is feasible if we can assign a proper value to i_x." Then he says the company's average interest rate doesn't remain level, but, he says, "However, by taking the average interest rate earned during the past five years, conservatively adjusted with an arbitrary factor to allow for the rising or falling tendency, we can obtain i_x sufficiently correct for all practical purposes." That, it seems to me, may be very well "for all practical purposes," but when you have passed beyond a certain period, when you have come to estimate what the company's average earnings will be, you necessarily take account of this valuation of these bonds. It seems to me this method will by being carried forward tend to carry forward a false interest rate developed from itself, and that your actual interest earnings may rise or fall considerably according to the purchase of new bonds and yet the showing be considerably distorted by the fact of an amortization resting upon an interest earning assumed from a past earning.

Turning to the second part of the paper: He divides the multiple line companies into two groups, those that are subject to the catastrophe hazard and those that are not, and of course he classes workmen's compensation properly in with the group that is subject to catastrophe hazard, and yet it does not seem to me necessarily that that precludes that group of companies from consideration as to the amortization principle. For, at least in workmen's compensation, and I think in some other lines, you may have a catastrophe loss which does not have to be paid immediately but by the operation of the compensation law is spread over a considerable period of time, which would give a company considerable leeway in handling its investments and would not necessarily require an immediate sale of a considerable volume of them. So that it does not necessarily follow that a catastrophe loss of that kind would get a company in trouble when it was using the amortization principle in valuation.

Mr. Benedict D. Flynn: There are objections to the use of Mr. Wolfe's method of obtaining amortized values of bonds which it seems to me outweigh the advantages pointed out by him. Before discussing them, however, I would like to emphasize the fact that the effect of Mr. Wolfe's method is simply to modify the amount of the interest payment under the bond which goes to interest on the one hand and to amortization of premium of the bond or accrual of discount on the other. For instance, a premium bond the effective rate for which is adjusted upward to reflect current interest earnings will show higher amortized values and larger interest return than if the amortized values for the bond which were established at date of purchase are adhered to, for the reason that

a smaller part of the interest payment will go to repayment of principal and a larger amount to interest.

It appeals to me that if a company adopts a plan of amortization of its bonds, the plan should give a set of amortized values which would not be susceptible to change. Mr. Wolfe's plan of modifying the effective rate to agree with the average interest rate earned during a preceding short period appears to me to give too much leeway to the company in the application of the amortization plan. One can easily imagine instances where the total amortized values of a company's bonds would be materially changed, possibly upward, if the change in interest rates were important. The possibility of a rapidly growing company, or a company with a distinctive class of bonds, experiencing a material change in the total value of its assets if the effective rate of interest were changed, say, from four to five per cent., constitutes a serious objection to the use of the plan.

Another objection is based upon the fact that an insurance company which carries the amortized value as the book value of its bond, makes the assumption when it purchases its bond that the purchase price with the resulting effective interest rate gives a certain status to the bond and that so long as interest payments are made under the bond when due, the company can consider the amortized value from year to year upon the effective rate of interest as the book value in its valuation of assets. The effective rate of interest under the bond reflects the rating of the character of the security given to it in financial circles at the time of purchase. The insurance company, in order to eliminate the effect upon the value of its assets which would result from widely fluctuating market quotations year after year, accepts this rating and adopts a set of amortized values which shall be used as book values until maturity of the bond. It seems to me that any modification of amortized values during the period of the bond is a step in the wrong direction and weakens the position of the insurance company in its original assumption.

I would like to endorse strongly Mr. Wolfe's plea for the privilege of amortization of bonds by the miscellaneous casualty insurance companies. The two possible dangers which might require forced liquidation of assets are so remote, as pointed out by Mr. Wolfe, that with proper supervision the amortization of bonds could be permitted to the miscellaneous company with just as great safety and just as great usefulness as to the life insurance company. The outgo of funds in a casualty insurance company does not fluctuate to any material extent. Possible catastrophes are provided for by proper reinsurance arrangements. Further, the character of the business of certain casualty lines, such as workmen's compensation, involves in claim payments long term contingencies—life annuities which may run thirty or forty or more years. It is my firm belief that the bonds which are of the proper grade to be included in an amortization plan should be valued upon such a basis in every casualty insurance company.

SOME PRINCIPLES OF COMPENSATION MERIT RATING—E. H. DOWNEY.

VOL. III, PAGE 26.

ORAL DISCUSSION.

MR. S. BRUCE BLACK: Mr. President, I think the majority of those who would discuss this paper have been very busy since the first of the year and have not had very much opportunity to give it proper study.

Two objects of schedule rating, as Mr. Downey has brought out, are, first, to induce measures being taken to prevent accidents, and, second, to measure the differences in hazards between individual risks in the same rate class. In the past, schedule-rating plans have been constructed with very little regard to actually measuring the loss producing characteristics or particular conditions of the risks insured. The persons who have constructed the schedule-rating plans have been engineers chiefly who have had more knowledge of the cost of correcting an unsafe condition in the plant than they have had of the loss-producing ability of such a condition of the plant. The result is that schedule-rating plans have tended to decrease materially the premium income collected from the total business.

The "Actuarial Sub-Committee" of the recent rate conference found it necessary to put a loading of 9 per cent. into the basis rates to take care of the probable reduction in the premium income that would result from the use of the Industrial Compensation Rating Schedule, for an insurance company cannot give anything as an inducement to accident prevention that it does not collect. There is a question as to whether it is proper for any schedule-rating plan to produce such a premium decrease which must be made up by an increase in the basis rate itself. We must be sure, in assuming such a public function as the collection of a fund by a tax upon all industry to be redistributed as inducements to accident prevention, that we are properly assessing that cost.

In the present compensation rates, we make a flat assessment of 9 per cent. on all classifications subject to schedule rating. A majority of schedule-rating plans do not collect as charges because of unsafe conditions as much money as they give out as credits or reductions to those who have better than ordinary conditions. A flat assessment ignores completely the particular characteristics of a particular class of industry. The schedule-rating plan may produce neither charge nor credit on a certain broad group of industries, while on another broad group it may give a reduction of

20 per cent. It is of questionable propriety to assess an average of 9 per cent. over all classes because that happens to be the average reduction resulting from the use of the schedule. If we are to continue the use of such a schedule-rating plan which requires the collection of a loading in the base rate itself, we must make our rate determination a little more complicated and adjust our base rate to the particular effect upon the particular class of industry of the use of such a schedule.

An alternative is the use of a schedule-rating system that will adjust itself to the differences in industries and have the same effect upon all classes.

Mr. Downey, using to a certain extent the principle upon which is based the Coal Mine Schedule used by the Associated Companies, proposes a system that will adjust the item values in the rating schedule to different classes of industry. He would also base the values in the schedule entirely upon accumulated accident statistics of cost. It is true that such statistics do not exist or rather, have not been collected, but before a schedule-rating plan can be constructed that will both measure deviations from average hazard and offer all inducement to accident prevention which can be given by the money that can be collected in a plan that can collect as much as it gives out, there must be a statistical basis. As Mr. Downey brings out, with appropriate emphasis, a schedule-rating plan must be based upon statistics, and must be subject to statistical control.

NOTE ON AN APPLICATION OF BAYES' RULE IN THE CLASSIFICATION OF HAZARDS IN EXPERIENCE RATING—ARNE FISHER.

VOL. III, PAGE 43.

ORAL DISCUSSION.

MR. EDWIN W. KOPF: Mr. President, I wonder if our statistical members appreciate the significance of one sentence in the concluding paragraph of Mr. Fisher's article?

"It is up to the statisticians to take a more conciliatory attitude towards the introduction of mathematical methods in statistics instead of taking a suspicious, if not actually acrimonious and ignoring attitude towards the lonely little band of students who attempt to reach a mutual understanding with the mathematicians."

I had occasion to discuss Mr. Fisher's work with a number of teaching statisticians recently. I found that they had only read Professor Edwin Bidwell Wilson's review* of Mr. Fisher's initial volume on the mathematical theory of probabilities, and frankly admitted not having read the book itself. They acknowledged, also, that they had not made themselves acquainted with the newer conceptions of statistical analytics advanced by the Scandinavians, the German school under Lexis, and by the English biometricians. This lack of ready acquaintance with the really "practical" aids to statistical analysis and to the testing of the reliability of statistical conclusions, is deplorable in teachers of statistics. It may partly be ascribed to the absence of a suitable text for purposes of statistical instruction in our American schools and colleges.

Throughout previous discussions of Mr. Fisher's articles there has been an unfortunate characterization of statistics as "merely practical" on the one hand, and as "merely theoretical" on the other. It is about time we ceased to conveniently, but falsely, distinguish between these two alleged natural classes of statistical subject matter. We have recently had an illustrious example of the intense practicability of the "merely theoretical" in surgical statistics, a branch of that larger subject of general medical statistics in which casualty statisticians should strive to become proficient.

The eminent French surgeon, Dr. Alexis Carrel, in association with Dr. Alice Hartmann, proceeded by the ordinary "practical" methods of direct observation and description to collect the necessary surgical facts for a statement of the "normal law of cicatri-

* Quarterly Publications of American Statistical Assn., December, 1916, p. 468.

zation." They concluded, among other things, that the rate of normal healing of a wound is greater at the beginning than at the end of the period of repair; that the rate of healing depends upon the area more than upon the age of the wound; and that there appeared to be a constant relation between the size of the wound and the rate of cicatrization. The method of simple description and observation is not in itself sufficient to establish a basis for the numerical expression of a "normal law of cicatrization." In other words, description alone (as far as the "practical" statisticians are in the habit of going) did not conclusively state in numerical terms the relation between the area of a wound, the rate of cicatrization and a constant characteristic of the case, say, the age of the patient.

Carrel turned over the *descriptive* data to the French mathematician and physicist, Pierre Lecomte Du Noüy, for *analytic* study and for the formulation of the "normal law of cicatrization." Du Noüy devised a simple extrapolation formula, which can be found fully explained in the *Journal of Experimental Medicine* for November, 1916. The French physicist maintained that the cicatrization of sterile wounds could be studied in precisely the same way as other physicochemical phenomena. The formula developed by Du Noüy calls for the calculation of an "index" for each case, from plotted curves representing the observed relation between the age of patients and the area of the wound in a test series, and the employment of this "index" in the computation of the theoretical area of the wound after a given lapse of time from the date of first observation. Thus, given an "index" of 0.0416 for a certain patient at a stated age, with a sterile wound of an area of 9 sq. cm., we can estimate that four days later the area of the wound will be 6.45 cm., and three days after that, 4.84 cm., etc.

The plotting of the ideal curve for the individual, suited to the age of the patient and the area of the wound, enables this mathematician at Hospital No. 21, Compiègne, France, to predict the probable date of discharge of a surgical patient. The "practical" surgeon, in arranging for the efficient movement of the sick population under his care, makes use, first, of *description* of a series of representative cases, and second, of *analytic* study of the cases and the statement of a general law covering the surgical phenomenon of normal healing of wounds.

As "practical" men, therefore, we ought to take a page out of the book of the French surgeons' experience and abolish the useless emphasis upon and distinction between the two older concepts of statistics as (*a*) theoretical and (*b*) practical. We ought to earnestly desire union between the two schools and establish a tentative working definition of statistics in the service of American casualty practice as: (1) *description* of masses or groups of persons, things and events, in terms of the mass or group, (2) mathematical and other *analysis* of statistical description, especially in

testing the reliability of conclusion based upon statistical results.

MR. ALBERT H. MOWBRAY: If many of our members have had the same experience I have, they should certainly be grateful to Mr. Fisher for presenting this paper, because I remember in my preparatory work for my examinations studying through inverse probabilities, as we call them, and finding them an extremely hard subject and one the practical value of which I found it very hard to estimate or gauge. I am therefore very glad to see some one put forward a practical application of some of the theories of inverse probabilities and one which does seem to have a practical value. With regard to the example Mr. Fisher cites, it seems to me that there is one considerable difficulty, in that he takes as his criterion, as I recall it, a loss of a certain size, without regard to what might be the cause or makeup of that particular loss. I assume that that is not subject to such very great criticism, because, as I understand it, this note is presented rather as an illustration of the theory than as an attempt to solve the particular problem that is used as the illustration. I am the more moved to make these remarks here from seeing a letter from a rather—well, I don't know just what I want to say, but at least from a safety engineer, who very evidently has not at all carefully read the paper and who referred to some men appearing in the Casualty Actuarial and Statistical Society and attempting to substitute an integral sign for a safeguard and some mathematical formulae for a safety engineer. I think the entire spirit of the paper has been misinterpreted by the engineers, and I think that if the engineers and some of us who are working on safety ratings would study some of the things that this paper has intended to bring to our minds, we might all profit considerably.

MR. JAMES D. CRAIG: The first point that appealed to me was the lack of any definition of Bayes's Rule. As Mr. Mowbray says, it is what we commonly call inverse probabilities. Mr. Fisher in his book, which I happen to have with me, states: "English writers have lost sight of the true Bayes's rule and substitute a false, or, to be more accurate, a special case of the exact rule in the different algebra books under the discussion of the so-called inverse probability." It seems, therefore, that what we commonly know as inverse probabilities is really a special case of Bayes's Rule.

Mr. Fisher might help us out more in his papers if he would give a little more detail; lead us along slower as it were. For instance, on the top of page 44 there are some integrations, but the functions used are not defined. Evidently (y) is the probability of an event's happening, and $(1-y)$ the probability of its not happening. The integration is between 0 and 1, for the reason that y being a probability cannot have a value exceeding 1. Again from the expression given, Mr. Fisher deduces the factorials on the top of the next page. These are a little hard to see, without some study, although they are not hard to deduce. Integrating

by parts, the second part will be an expression with the power of y decreased by 1 and of $(1-y)$ increased by 1, while the first part is a quantity which reduces to 0, when the limits are substituted. Continue integrating by parts, and each time the first part vanishes when the limits are applied; while in the second part the exponent of y decreases, and that of $(1-y)$ increases by unity each time. The coefficient of the second term receives an additional factor in both numerator and denominator, so that after m such integrations the y term becomes unity in the last integral. Before multiplying by the constant $\frac{\lfloor t}{\lfloor n \lfloor t-n}$ the numerator for the expression $P_{(t,\,n)}$ is therefore $\frac{\lfloor m+n \lfloor S-m+t-n}{\lfloor S+t+1}$. The denominator is $\frac{\lfloor n \lfloor S-m}{\lfloor S+1}$ giving a value for $P_{(t,\,n)}$ of

$$\frac{\lfloor t}{\lfloor n \lfloor t-n}\left[\frac{\lfloor m+n \quad \lfloor S-m+t-n \lfloor S+1}{\lfloor S+t+1 \lfloor m \lfloor S-m}\right].$$

Mr. Fisher evaluates this expression by Stirling's Law as given on page 101 of his book.

In the second example, on page 45, it might be of some advantage to express that probability and its answer in terms with which we are more familiar. The probability is: having 80 events occur out of a possible 100, what is the probability that exactly 3 events will occur out of 25? In this form we would probably recognize it, ascertain the value by extending the binomial $(\frac{8}{100}+\frac{92}{100})^{25}$, to where the exponent of $\frac{92}{100}$ is 3, the value of which term represents the answer. It works out to .185020. When the answer is comprehended, it is simple to realize that the table on page 46 is a list of the probabilities that the event y will occur exactly 0, one, two or three, etc., times.

This is not meant as any general discussion of the paper, but simply as a possible help to those who might wish to study the expressions.

MR. ARNE FISHER:

(AUTHOR'S REVIEW OF DISCUSSIONS.)

Mr. Craig is justified in saying that I have not given the detailed steps in the derivation of the various formulae. However, I referred to the discussion on page 101 in my work on probabilities where the detailed work is shown and did not consider it worth while to reprint this in the paper.

The variations in the second example may all be explained as due to sampling. This, however, does not eliminate a loss con-

siderably higher. You might indeed have a loss, due to a catastrophe and which might exceed the total payroll several times. In order to treat all those variations one had to go to a detailed study of the frequency curves of such losses. What I wanted to emphasize was that many of the losses might simply be due to pure sampling and not to a special cause or condition in a particular factory.

Bayes's Rule, dating from 1763, has been forgotten and only used in examination questions, which often plainly show that the examiners have no idea of the importance of the theorem. I have recently had some correspondence with Major Greenwood, of the Lister Institute of Preventive Medicine of London, wherein he informs me that he and Mr. Yule, whose admirable text-book on statistics you probably all know, have made some researches on the Theorem of Bayes, but due to the war stress, it would probably be some years before they would be able to publish the final work.

In regard to Mr. Kopf's remarks I feel thankful for what probably is the first encouragement I have had in my work on mathematical statistics in this country. Mathematical statistics is by many regarded as a brand new science. The fact is, however, that it by no means is a stripling baby, but a science with old and renowned ancestors. Its family tree dates back to a time when the word statistics was unknown, because no statistical data were collected. The "Ars Conjectandi" by James Bernoulli and the "Doctrine of Chances" by de Moivre were written before the American Revolution. These earliest works on probability can still be read to advantage. The greatest work on the subject is, however, Laplace's "Theorie des Probabilités," published at the beginning of the nineteenth century. You will therefore see that you have possessed a first class technique, as fine a set of tools as you could wish, for more than 100 years. Why have you not used the tools? The subject of frequency curves is treated in Laplace's book, and his treatment is, as Charlier has shown, the most general we possess. Correlation, of which we hear so much of late, was introduced by the Belgian astronomer, Bravais, in 1846, but it was never used until Sir Francis Galton applied it to statistical measurements in the early eighties.

After that the biometric school of England grew up under the very able leadership of Pearson. Pearson and his pupils do excellent work, but their attitude is often one-sided, and many things they consider as new discoveries are really old things treated in a different way by the old French classics. We Scandinavian statisticians have tried to bring the old French masters and the modern Englishmen together and view their researches from a common point of view. How far we have succeeded I leave to others to judge.

The reason that the English speaking world has lost sight of the wonderful mine of information contained in Laplace's book on

probabilities I think is due to the fact that it was written during the Napoleonic wars, in fact, the first volume was dedicated to Napoleon, and of course you know that the English did not have any great love for anything connected with Napoleon round 1800–1814, and consequently they did not read much of Laplace. I hope earnestly that one result of the present war will be that English speaking statisticians, both in England and America, will turn their eyes toward that old volume of Laplace and will study it, and I can assure you that you will derive much benefit from it.

Reviews of Books and Publications.

Modern Insurance Problems. Edited by S. S. Huebner. Philadelphia, American Academy of Political and Social Science, 1917. Pp. 323.

The March, 1917, number of the *Annals* of the American Academy of Political and Social Science is devoted to a study of modern insurance problems. The volume is divided into three parts—(1) life insurance; (2) fire insurance; (3) casualty insurance. The subjects are treated in a popular and non-technical way by practical insurance men of wide experience.

The life insurance division opens with an excellent outline of the value of income policies as a means of continuing the family income after the death or retirement of the wage earner. Annuities are recommended as a safe and logical investment for a person who has no dependents and is chiefly interested in the maximum yield during his or her lifetime. There is an explanation of the way in which life insurance may be safely granted to many persons who, because of some impairment, are not eligible for regular policies at normal rates. The benefits and evils of cash values and policy loans are presented. The mutualization of life insurance companies is discussed with special reference to several large eastern companies. Life insurance companies are urged to carry on a campaign to prolong life by the elimination of preventable disease. The principles and social value of group insurance are explained. One chapter is devoted to fraternal insurance in the United States, one to the taxation of life insurance funds and another to the recent progress in disability protection under life policies. The life insurance division closes with a discussion of the trend towards elimination of part time agents except in sparsely settled country districts.

The fire insurance section opens with a strong appeal for reduction of the appalling American fire waste. This is followed by discussion of the conflict between competition and co-operation as the basis for rate making. Then comes an outline of the comparative values of state regulation of rates fixed by companies and the actual fixing of rates by state officials. There is a review of

the development of schedule ratings as the basis for fire insurance premiums and a reference to a recent effort to provide a statistical foundation for rates in order that the premiums may reflect the actual experience. The section closes with a discussion of the ways in which an insurance company may guard against the catastrophe hazard.

The casualty section opens with a description of the disability insurance policy followed by a discussion of the recent movement towards accident prevention. The remainder of the section is devoted to workmen's compensation insurance. In a paper on "Methods of Insuring Workmen's Compensation" there is a discussion of the various classes of insurance carriers, namely, joint stock companies, state insurance funds, mutual employers associations, reciprocal exchanges, and self insurers. After an explanation of how premium rates are calculated there is a review of schedule rating and experience rating, the two systems of distinguishing between risks in the same general class but with different degrees of hazard. After a comparison of employers' liability and workmen's compensation, including a summary of the principal benefits payable under workmen's compensation, problems of administration and adjustment are discussed. The section closes with an exposure of the weaknesses of present license laws and reserve requirements and an outline of the difficulties involved in state regulation of rates.

Although this volume was intended primarily for the general public, it will be of distinct value to any insurance man who wishes to get a broad view of the entire business.

JOHN M. LAIRD.

United States Life Tables, 1910. By James W. Glover. Bureau of the Census, Division of Vital Statistics. Washington, D. C., 1916. 75 cents.

Resulting largely from the initiative of Dr. Cressy Livingston Wilbur, formerly Chief Statistician for Vital Statistics of the United States, the Bureau of the Census has published a preliminary report on life tables for the registration area of the United States and its principal subdivisions. A technical criticism is not possible at this time because the original data and the discussion of methods employed in compiling the tables are to be published in a second volume at a later date. A few historical notes may be given, however.

The tables fulfill the hope expressed by Joseph C. G. Kennedy, Superintendent of the Eighth Census of the United States, who emphasized in May, 1862, the lack of adequate registration returns for purposes of a life table and pointed out the essential uses of tables covering a considerable portion of the country. Up to that time, the only life table for any extensive area in the United States had been the table for 166 towns in Massachusetts, compiled by the distinguished statistician and actuary, Ezekial Brown Elliott, for the year 1855. Later, for the 1870 Census, Mr. Elliott constructed an approximate life table for the United States as a whole. He used the enumerators' returns for population and deaths in 1870, and assuming a deficiency of 41 per cent. in enumeration of deaths, compiled a life table which he held to compare favorably with similar data published for the principal countries of Europe at that time.

The 1880, 1890 and 1900 Census publications on vital statistics contained the approximate tables compiled under the direction of Dr. John Shaw Billings. These approximations were developed according to the so-called Humphrey method, a short-cut device current in England at the time.

The 1910 tables surpass any of their predecessors, both in the number of classes and areas of the population covered and in technical excellence. The Bureau of the Census promises in a later report to publish the original data and a detailed account of the methods employed in deriving the tables. Similar tables for the years 1890 and 1901, and for the decennium 1901–1910 are in course of preparation. Professor Glover has contributed to the meetings of the American Public Health Association at Cincinnati in October, 1916, a popular exposition of the life tables. This discussion will probably be published at an early date in the Journal of the American Public Health Association.

In this series, a life table is given for the entire area comprehended by the group of ten "original registration states" of 1900. Further tables are presented for the white and negro, native born and foreign born white and the white urban and rural classes of the population. For each class the figures are distinguished for sex. Tables classified by sex are given for Indiana, Massachusetts, Michigan, New Jersey and New York. The tables exhibit, among other things, the rate of mortality per thousand, the complete expectation of life in years and the average annual death rate per thousand.

The table forms and headings are sufficiently explicit to make possible intelligent use of the material. Life tables appeal to a variety of interests in the community and the nomenclature of such tables should be reasonably elementary, as in this instance. Each column of the tables bears four designating legends, the column number, an algebraic symbol or convention employed by actuaries to represent the figures in the column, a sentence explicitly defining the symbol, and an abbreviated title for the column. Eight pages of explanatory text accompany the tables.

The life tables have considerable significance apart from their uses in the public health movement and for the demographer, publicist and economist; they have particular value for the casualty insurance statistician and actuary. First of all, the tables provide material hitherto lacking for the computation of present values of death benefits arising under workmen's compensation acts. The continued use of the Danish Survivorship Annuitants' Table of Mortality as indicated by Messrs. Greene (*Proceedings,* Vol. I, p. 31), Mowbray (*Proceedings,* Vol. I, p. 308) and Fondiller (*Proceedings,* Vol. II, p. 110) seems called to question. The adaptation of these tables for general population classes to the computation of net values for sickness insurance has the distinguished precedent of Dr. H. Renfer's series of tables for Switzerland, based upon Professor Moser's Berne Cantonal Sick Benefit Fund Table and the Swiss Mortality Table for 1881–1888.*

EDWIN W. KOPF.

Report of the Industrial Accident Commission of the State of California from July 1, 1915, to June 30, 1916. San Francisco, 1916. 152 pages and 9 colored charts.

This is the fourth report of the California Commission which administers the compensation laws of that state. The first report (of the Industrial Accident Board as the commission's title then was) covered the period from September 1, 1911, to December 31, 1913, the second the calendar year 1913 and first half of 1914, and the last two the years ended June 30, 1915, and 1916, respectively.

* Renfer, H., "Beiträge für Krankenversicherung," St. Gall, 1912. (Gives in detail the statistical, actuarial and financial bases of sickness insurance.)

Jester, E., "The Mathematical Basis of Sickness Insurance," *Journal* of the Swiss Statistical Society, 1913, pp. 493–505.

Incidentally it may be noted that these annual reports are by no means the only publications of the California Commission. There are three other series of its publications, of importance and interest. One contains the important decisions of the Commission on compensation cases, issued in pamphlet form at intervals of about a month; another comprises the general safety orders for prevention of accidents which have been established by the Commission; while the third is the monthly Safety News, a safety educational pamphlet the first issue of which was for January, 1917. The series of safety orders thus far issued covers each of the following in separate pamphlets: general safety (power transmission apparatus, grinding wheels, ladders, passages, floor openings, etc.), boilers, air pressure tanks, engines, donkey engine signals, electric power and transmission, mines, logging and saw mills, woodworking, trench construction, laundries, and window cleaning.

In this connection the writer is moved to note that he has not found in any of the California Commission's documents a list of its various publications. Such a list is a minor, but very useful, feature in connection with any such publications, which can be easily inserted on inside cover pages or fly leaves.

The report here reviewed follows very closely in topics covered and arrangement of matter the last previous annual report. Following two pages which briefly note the personnel of the Commission and staff, the extension of voluntary acceptance of the compensation law by employers for occupations not under its mandatory provisions, and the expenses of the commission, 5 pages are devoted to a review of court decisions on the compensation law, 26 pages are devoted to reports on administration by departments. leaving 115 pages devoted to a statistical report concerning reported and compensated accidents. The several administrative departments whose work is reviewed comprise those of compensation, permanent disability rating, medical, state fund, and safety.

It will be seen from the foregoing summary of page distribution that outside of accident statistics the report is decidedly condensed, comprising only 33 pages. In such a space it is possible, of course, to cover only in brief fashion the most salient features of the year's administrative experience. This is done succinctly, clearly, and in interesting fashion. At the same time it is a fair question, in view of the fact that we have now reached the stage in connection with workmen's compensation in which administrative problems are the

great problems and their solutions are far from being out of the experimental stage, whether such a report should not go into these matters much more fully.

Turning to the statistical report, this is devoted chiefly to the statistics of accidents which occurred in the calendar year 1915 (67,538 in number) but with some material also for accidents in the first half of 1916 (40,269 in number). In appraising such a statistical report there are two main points to be considered, first, its adequacy as to ground covered, and second, the form of presentation.

As to adequacy of material, the present report is quite comprehensive, covering with considerable detail the main subjects of industries, causes, nature of injury, extent of disability, and amount of compensation. Unusual data are given as to percentage of physical impairment in permanent disability cases, and as to after histories in permanent injury cases. The former material is afforded by the very detailed system of disability rating used in California, while the latter was obtained by special investigations, a line of study in connection with compensation administration very much to be commended. The report itself notes with regret that it was impossible to secure figures as to number of employees exposed to accidents as a basis for rates. In this respect California suffers in the same way as nearly all the other states at the present time. It is to be hoped that the recognized difficulty and expense of securing such data may before long be met in the several states in view of the great value such information would add to accident statistics.

In connection with this topic of adequacy of data, the reviewer is moved to call up one point on which the great majority of such reports everywhere up to this time have been defective and in respect of which the present report, while less open to criticism than many, is not without faults. This is the matter of careful definition of terms used, particularly as to just what is included or excluded in any particular class. Even when the various classifications used in tables seem to make matters clear, there should be somewhere in every such report precise definitions so that no possible doubt may arise on any point.

Taking up the matter of form of presentation, there are many tables in a variety of forms and more than thirty charts besides four pages of rather gruesome photographs of permanent injuries.

Apparently there has been an attempt to avoid extended tables. In the present writer's judgment this splitting up of material into small tables has been carried to the point of seriously obstructing some of the most important comparisons of figures which such a report should yield. To cite but one out of several possible illustrations, no table is to be found comparing accidents in different industries according to extent of disability. Such a table can be compiled for the main industry groups (the figures for industry subdivisions for fatal and permanent injuries are entirely lacking) but only by bringing them together from different tables separated by many pages in the report. This comes about because the basic plan of the statistical report is to present in separate series of tables the data for fatal, permanent injury, and temporary injury cases. This sort of separation is carried for one item—part of person injured—to the point of employing different classifications in the different sections so that no combination figures for all accidents are available even by compilation.

A point to be commended in the report is the more than usually detailed analysis of causes presented for each of the main industry groups. The results would have been much more effectively presented, however, had they been arranged in tabular form instead of in the crude form of text enumerations which reveal comparisons but clumsily. This sort of failure to produce the greatest facility of comparison of the figures, always a prime desideratum in a statistical report and fundamentally so in statistics of accidents, is the chief shortcoming as to form in the present report.

The reviewer of such a report must, of course, take account of the fact that in this country we are still just at the beginning of the development of accident statistics in connection with compensation laws. On the whole this California report is distinctly indicative of progress in this field. But there is still room for, and great need of, improvement everywhere in such reports.

One thing which must forcibly strike anyone who considers such reports is the lack of uniformity among them as to material or presentation, particularly in relation to statistics, especially so when one is aware of the great value which the figures for one state have for others, and still more the value which combined figures for different states would have for each. It is, perhaps, not out of order here, therefore, to urge the great desirability that all officials preparing such reports should study and follow so far as possible

the standards which have been prepared by the Statistical Committee of the International Association of Industrial Accident Boards and Commissions.

LEONARD W. HATCH.

Report of the Social Insurance Commission of the State of California. Sacramento, 1917. Pp. 340.

Health insurance now occupies, in the United States, much the same position that workmen's compensation had attained some eight or nine years ago. A measure of public interest has been aroused, learned societies are discussing the subject, reform associations are agitating for legislation, a number of public investigative commissions have been created. The obstacles to be overcome are nearly the same as those which confronted the early advocates of accident compensation: the *vis inertia* of legislators and the public, the suspicion of labor leaders, the selfish opposition of vested interests. Private insurance companies, in particular, are running true to form; their efforts to preserve the thoroughly antisocial business of "industrial" insurance have produced no arguments not already exhausted in defense of employers' liability insurance.

Pursuing the analogy, the report of the California Commission seems destined to play a rôle in the present movement not unlike that of the Wainwright Report to the New York Legislature in the development of workmen's compensation. The two documents, indeed, are strikingly similar in scope and character. There is the same broad survey of conditions in America and Europe, the same showing that our extant institutions, whether for prevention of relief, are inadequate, inefficient, disjointed, the same persuasive arguments for a comprehensive and socialized insurance. Only in the constructive recommendations is there a falling off from the high standard set by the Wainwright Report. The California Commission was apparently too timid to propose a positive program or prepare the draft of a bill.

The Commission, which consisted of three women and two men, was appointed in August, 1915, and submitted its report in January, 1917. It was so fortunate as to secure the assistance of the distinguished past president of this Society in the most important parts of its work. The Report itself comprises, besides the findings and recommendations of the Commission, a survey of illness and

health insurance among wage earners in California, a discussion of social insurance principles and their development in the United States, a brief resumé of health insurance in Europe and an actuarial estimate of the cost of health insurance in California. To professional students, the most interesting and valuable sections are those devoted to the California survey and to the cost estimates. To the general public, however, Dr. Rubinow's able summary of European health insurance systems should prove extremely useful.

The California Survey was necessarily fragmental because the legislature, with true American economy, failed to provide the funds for an adequate investigation. Yet enough data was brought to light to show that the cost of efficient medical service in California is far beyond the reach of the ordinary wage earning family, that free hospital facilities are grossly inadequate, that wage loss from sickness is an important source of poverty, that relatively few wage earners have any form of health insurance and that it is precisely those most in need of such protection who benefit least of all from existing institutions. Of the present carriers of health insurance, by far the most important are the fraternal societies, with some 300,000 sick benefit members. Next in rank are the labor unions, who insure some 40,000 persons aaginst sickness. Employers' establishment funds—usually maintained at the cost of employees—cover about the same number. Commercial insurers, who have talked so loudly of their vested interests, carry health insurance on barely 20,000 persons, very few of whom are wage earners. The fraternals and trades unions most commonly provide a small cash benefit. Only a minority furnish any medical aid; fewer still have hospital facilities of their own. None pretends to offer highly skilled services or to maintain sanatoria. Establishment funds, on the contrary, specialize in medical benefits—generally of an inefficient type, by contract physicians. On a still lower plane are the commercial "hospital associations"—maintained solely for private profit. Almost none of the insurance carriers affords any protection to the insured's family.

The actuarial calculations appended to the Report follow the methods already familiar to members of this Society through Dr. Rubinow's *Standards of Health Insurance.*

The findings of the commission are especially interesting in the points of dissent from the bill sponsored by the American Association for Labor Legislation. Like most disinterested inquirers

the Commission oppose any commercial exploitation of health insurance and favor the principle of compulsion. They also favor the familiar tripartite division of costs. But they propose that the cash benefits shall be paid out of the contributions of the assured and be administered by workmen's societies—either the existing fraternals and trades unions, or new associations formed for the purpose. Medical and hospital benefits, on the other hand, are to be administered by an exclusive state fund and paid out of the contributions of employers and the state. An intermediate type of establishment and trade funds is to be permitted when both employers and employees so desire. It is believed that this scheme will better utilize existing institutions, better co-ordinate medical service, and create less friction between employers and workmen, than the *ad hoc* organizations of the Association's bill.

E. H. DOWNEY.

Report of the New York State Industrial Commission from October 1, 1914, to September 30, 1915. Albany, 1916. Pp. 417.

The report of the Bureau of Workmen's Compensation, which covers a period of the calendar year 1915, with tables that make it also a report for the last nine months of the fiscal year ending September 30, 1915, is divided into two parts, and consists of 47 pages. The first of these is prepared by the second deputy commissioner in charge of the Bureau and the second has reports by the manager and the actuary of the State Insurance Fund. This document is incorporated in the annual report of the Industrial Commission.

At the beginning of the year the administration of the Workmen's Compensation Law was in charge of the Workmen's Compensation Commission. On June 1, 1915, the supervision of the law passed from their hands to the new State Industrial Commission, at the head of the new Department of Labor, and in the Department of Labor a Bureau of Workmen's Compensation was formed. During the year, therefore, many radical changes were necessary, due to the transfer of control from a Department to a Bureau, and also due to the amendments which the Legislature made to the "July 1, 1914, Compensation Law" and which took effect April 1, 1915. These changes in the methods which had been adopted by the old Commission all tended towards greater efficiency and economy.

In the report about ten pages are given over to the various divi-

sions of the new Bureau. It is to be noted that the duty of compiling statistics of compensation accidents, as well as other accident statistics, has been allotted to the Bureau of Statistics and Information. No statistical department had been organized in the old Workmen's Compensation Commission, although the consideration of the statistical analysis of claims had been planned. The Bureau of Statistics and Information will conduct its work along lines which may be regarded as permanent, and it will add much to the value of the results obtained. They also report that they are observing closely the standardization and uniformity of accident statistics.

Following the section of the report concerning the Claim Division, several pages are devoted to tables giving an analysis of the awards made under workmen's compensation in New York State for the period from July 1, 1914, to March 31, 1915, with the experience brought down to December 31, 1915. The careful analysis, which is here set forth, is very good as a beginning, but it is regrettable that we have no tabulation of non-compensated accidents (those accidents where the disability is of two weeks duration or less). Statistics covering these accidents are important from several points of view. New York is the largest industrial state in the Union and has one of the most elaborate compensation laws, and the opportunity of furnishing statistics covering accidents of all kinds is great. It is of vital importance that we take advantage of the opportunity which is thus presented. We should have complete statistics on non-compensated accidents and fuller statistics on compensated accidents. The Bureau of Statistics and Information report too small a force for handling the business, and we trust that this can soon be remedied so that we can look forward to the publication of non-compensated accident statistics in the near future and know that the statement of the Bureau, namely, that it is uncertain when the tabulation of non-compensated accidents can be undertaken, will not come true. Again, the problem of securing full and accurate data concerning the causes of accidents should be faced and solved. These data are of the utmost importance in the study of prevention, and we are daily being deprived of information which will be invaluable if properly reported and tabulated.

The report of the Manager of the State Insurance Fund occupies fifteen pages. It shows an increase of about 19 per cent. in the

number of new policy holders for the year ending December 31, 1915, over the first six months of the Fund's existence. A surplus of $231,670.12, which was a gain of about 30 per cent. over the surplus at the end of December 31, 1914, is reported. The loss ratio for eighteen months ending December 31, 1915, is 64.8 per cent. The volume of premiums in force was slightly smaller on December 31, 1915, than at the close of the previous year. The report touches on the criticisms made against the Fund by some of the stock companies and urgently demands that the State Fund be regarded as an active competitor for business and not merely a passive receiver of damaged goods for private companies. The Actuary, in his report, gives us statistics concerning 10,000 and more accidents reported to the New York State Insurance Fund during the year ending June 30, 1915. The experience is brought down to December 31, 1915. These data are indeed interesting, but cover too small a number to be of real statistical value.

From a statistical point of view the report of the Bureau of Workmen's Compensation is disappointing, but full of promise; disappointing because of the lack of full and complete accident statistics; full of promise because the work is now in the hands of a well-organized Bureau, which already has entered upon its labors and which encourages us to expect more and better statistics in the near future.

LESTER D. EGBERT.

Report of Illinois Pension Laws Commission. Chicago, Illinois, December, 1916. 310 pages.

The General Assembly of the State of Illinois in January, 1916, appointed the Illinois Pension Laws Commission to investigate the operation of all pension laws heretofore enacted in this state; to gather together all available information as to the present and probable future cost of maintaining the funds created by said laws and to collect all available information in regard to the operation of similar laws in other states and countries; to report the results of its investigations, together with any recommendations it may see fit to make.

The report of the commission is divided into two parts.

PART I. INVESTIGATIONS WITH CERTAIN COMPARATIVE STUDIES.

Some conclusions to be drawn from the brief survey of pensions systems in effect in foreign countries are "that the systems vary from those operating loosely without much regard for the probable future cost, to those kept actuarially sound on the theory that a class of persons of given age and service should be accumulating a sufficient fund to pay their own pensions; that the age of retirement is generally 65 years; that the amount of the pension is rarely based on final salary but is generally a per cent. of average salary multiplied by years of service."

The Actuarial Report shown in Part I gives some very valuable tables, especially in the cases of policemen and firemen. The descriptive part of the report explains in detail the very careful manner in which these tables were compiled. In the case of policemen the pensions in 1916 will amount to 13.3 per cent. of the salaries. At the time the fund is carrying its normal load, or in about forty years, this percentage will have increased to 34.3 per cent. These same percentages for the firemen's fund are 12.6 and 36.6 per cent. The balance sheets for the various funds show them all to be insolvent at the present time. This condition agrees with the condition found in most of the pension funds examined in other parts of the country.

Appendix *A* of the report contains a "Tabular Digest of Pension Laws Enacted in Illinois from 1852 to 1916." Appendix *B* contains a "Tabular Digest of Pension Laws in Force in Illinois, January 1, 1916."

PART II. UNDERLYING PRINCIPLES AND SPECIFIC RECOMMENDATIONS FOR A REVISED PENSION PLAN.

The commission brings up the following points for consideration in working out a revised pension system:

"1. The theory of public employee pensions.
2. The question of who should be beneficiaries—whether employees only, or their widows and children also.
3. The length of service and the age required for a pension.
4. The amount of the pension.
5. The method of providing funds for paying pensions—whether the payments should be spread over a long period in advance and accumulated with interest, or be made currently as pensions need to be paid.

6. The ratio in which employer and employee should contribute the requisite funds with which to pay pensions; and
7. The scheme of management."

Twenty years of service and an attained age of 55 are recommended as requirements for a pension. A minimum pension is recommended for all beneficiaries who have attained the prescribed length of service and age of retirement. An extra or sur-pension is to be added to the minimum pension for the higher paid employees. The advantages of the "Reserve" sometimes called the "Get Ready for the Future" Plan over the "Cash Disbursement" Plan of providing funds from which pensions are to be paid are clearly brought out. For the minimum pension the employee is to contribute one fourth and the employer three fourths of the cost. For sur-pensions the employee and employer are to contribute equally. Consideration is given to the matter of disability pensions and pensions for employees injured or killed, but not in the performance of duty.

The report is a valuable addition to works dealing with pensions funds and should be read by all interested in this particular subject.

EVERETT S. FALLOW.

CURRENT NOTES.

Community Surveys of Sickness in the United States.

In September, 1915, the Metropolitan Life Insurance Company commenced a series of community sickness surveys in representative cities of the United States. At the present time there are available the composite and individual results for the first four of these enterprises. Copies of the individual survey publications may be obtained upon application to the Company. The communities surveyed were Rochester, N. Y. (September, 1915), Trenton, N. J. (October, 1915), the State of North Carolina (April, 1916), and the City of Boston, Mass. (July, 1916). The time chosen for these surveys were such as to show the greatest and least seasonal sickness, and thus in the composite results give a fair picture of average conditions in an entire year. The statistics of five addi-

SUMMARY OF FOUR COMMUNITY SICKNESS SURVEYS MADE BY THE METROPOLITAN LIFE INSURANCE CO. NUMBER OF PERSONS SICK AND UNABLE TO WORK PER 1,000 EXPOSED, BY SEX AND BY AGE PERIOD.

Sex and Age Period.	Total.	Boston.	North Carolina.*	Rochester.	Trenton.
Males:					
All ages	18.5	18.1	19.9	17.8	19.5
15 years and over	22.9	21.6	25.4	23.2	24 8
Under 15	10.4	11.6	11.4	5.5	8.7
15–24	11.5	10.2	13.4	11.8	13.6
25–34	12.3	11.4	17.5	8.2	17.2
35–44	19.7	19.3	23.0	19.1	13.5
45–54	30.7	32.2	33.3	26.3	21.2
55–64	55.2	48.4	54.3	66.8	79.4
65 and over	118.0	109.5	142.4	115.2	140.8
Females:					
All ages	20.4	18.1	25.7	20.4	20.4
15 years and over	25.4	21.8	34.0	25.7	23.1
Under 15	10.3	10.3	11.2	7.9	14.5
15–24	14.5	11.9	19.5	14.8	7.9
25–34	19.8	16.2	29.0	18.2	22.6
35–44	24.0	18.1	41.7	24.2	22.5
45–54	30.9	25.6	47.7	28.5	31.8
55–64	47.0	42.5	63.2	45.8	31.7
65 and over	89.5	88.4	100.3	88.2	74.5

* White lives only.

tional sickness surveys are now in course of tabulation and these refer to Kansas City, Missouri, the Chelsea neighborhood in New York City, the States of West Virginia and Pennsylvania, and the city of New Orleans. The composite and individual results of the first four surveys are given below with distinction of sex and age period.

A computation of the average number of days' sickness per year, on the assumption that the rates of sickness developed in the composite survey apply uniformly throughout the year, is given below.

SICKNESS EXPERIENCE OBTAINED FROM FOUR COMMUNITY SICKNESS SURVEYS MADE BY THE METROPOLITAN LIFE INSURANCE CO.

Sex and Age Period.	Number of Persons Exposed.	Sick Persons Unable to Work.	Rate per 1,000 Exposed.	Average Days of Sickness During Year.
Males:				
All ages	87,232	1,618	18.5	6.8
15 years and over	57,030	1,304	22.9	8.4
Under 15	30,202	314	10.4	3.8
15–24	16,361	188	11.5	4.2
25–34	14,751	181	12.3	4.5
35–44	11,786	232	19.7	7.2
45–54	7,950	244	30.7	11.2
55–64	4,309	238	55.2	20.1
65 and over	1,873	221	118.0	43.1
Females:				
All ages	93,258	1,903	20.4	7.4
15 years and over	62,344	1,586	25.4	9.3
Under 15	30,914	317	10.3	3.8
15–24	18,369	266	14.5	5.3
25–34	15,832	313	19.8	7.2
35–44	12,272	295	24.0	8.8
45–54	8,472	262	30.9	11.3
55–64	4,996	235	47.0	17.2
65 and over	2,403	215	89.5	32.7

Standardization of Morbidity Statistics Tables.

At the fifteenth annual conference of State and Territorial Health Officials, Washington, D. C., April 30 and May 1, 1917, it was resolved to present morbidity statistics uniformly in health reports as follows:

(*a*) Chronologically, by calendar months.

(*b*) By age periods; five-year periods up to age twenty-five, and ten-year periods thereafter.

(*c*) By sex.
(*d*) Geographically, by principal areas within states.

Statistical Study of Causes of Unemployment.

In an article entitled "Unemployment and Personality," January, 1917, number of *Mental Hygiene,* a new quarterly, Dr. Herman M. Adler presents an original study of some causes of unemployment, other than the economic. He divided his cases into the following groups:

Paranoid personalities: Egocentrists, who, no matter what they experience, no matter what they desire, have their own ego as the center of every plot. Paranoid individuals perpetually get into difficulties and one is glad to be rid of them, if possible.

Inadequate personalities: Defectives, the feebleminded, and those suffering from deteriorating disease other than manic-depressive insanity or paranoid psychoses.

Emotionally unstable personalities: Persons of excessive emotional reactions, who tire of one thing before it is half begun and go on to another, the irascible, impulsive types.

Dr. Adler found forty-three "paranoids," thirty-five "mentally inadequate" cases and twenty-two "emotionally unstable" persons in ninety-nine studied.

Increase in Industrial Insurance Accident Mortality During 1916.

On the basis of recently compiled mortality statistics covering the experience of the Metropolitan Life Insurance Company during the year 1916 on nine million white lives insured in its industrial department, that company concludes that the accident rate for the working classes of the United States increased five points per 100,000 living over the mortality showing for 1915. This condition is contrary to the recent tendency toward a reduction in the fatal accident rate and may well be the result of the increased activity in industry and to the speeding up processes incident to war conditions. The following table gives a comparison of the detailed statistical results for 1915 and 1916:

There was a slight increase in the mortality from burns. The rate in 1916 was 8.4 per 100,000; this may be compared with a figure of 8.1 per 100,000 in 1915. Absorption of deleterious gases showed an increase in mortality from 2.5 to 3.0 per 100,000. Acci-

dental drowning showed a decrease in the rate from 11.9 per 100,000 to 9.5 per 100,000. The figure for 1915 was rather high because of the inclusion of the deaths in the Eastland disaster. With these deaths excluded, the rate for accidental drowning in 1916 would still have shown a slight decline over the 1915 experience. Traumatism by firearms increased in rate from 1.4 per 100,000 to 1.6 per 100,000. Falls caused more deaths in 1916 than in 1915, the two rates being 13.7 and 12.4 respectively. Machinery accidents showed a higher mortality in 1916 than in 1915, as did also steam railroad and street railway accidents and injuries.

NUMBER OF DEATHS FROM ACCIDENTS AND RATES PER 100,000 EXPOSED. METROPOLITAN LIFE INSURANCE COMPANY—INDUSTRIAL DEPARTMENT, WHITE LIVES, 1916.

Causes of Accidental Death.	1916.		1915.	
	No. of Deaths.	Rate per 100,000.	No. of Deaths.	Rate per 100,000.
Accidents and unspecified violence (total)..	6,635	73.5	5,861	68.9
Burns	754	8.4	687	8.1
Absorption of deleterious gases	270	3.0	214	2.5
Accidental drowning	858	9.5	1,008	11.9
Traumatism by firearms	140	1.6	122	1.4
Traumatism by cutting or piercing	17	.2	11	.1
Traumatism by fall	1,241	13.7	1,051	12.4
Traumatism in mines and quarries	91	1.0	81	1.0
Traumatism by machines	143	1.6	118	1.4
Traumatism by steam railroads	685	7.6	622	7.3
Traumatism by street cars	237	2.6	192	2.3
Traumatism by automobiles	795	8.8	486	5.7
Traumatism by other crushing and other vehicles	303	3.4	299	3.5
Electricity	93	1.0	62	.7
Other accidental and unspecified external causes	1,008	11.2	908	10.7

Mortality from automobile accidents and injuries showed by far the largest increase in the rate, for any of the specified causes of accidental mortality. In fact, these automobile accidents were alone responsible for three fifths of the increase in the total accident rate in 1916. In 1916 the rate was 8.8 per 100,000 as compared with 5.7 per 100,000 in 1915. Deaths from electricity also showed a slight increase in the rate, from .7 per 100,000 in 1915 to 1.0 per 100,000 in 1916. Accidental deaths caused by vehicles other than steam railroads, street railways and automobiles had slightly less mortality in 1916 than in 1915, the two figures being 3.4 for 1916 and 3.5 for 1915.

S. Bruce Black, at present statistician, has been appointed actuary of the American Mutual Liability Ins. Co.

Richard H. Cole has been elected secretary of the Connecticut General Life Insurance Co.

Winfield W. Greene has been appointed Special Deputy Commissioner of the New Jersey Department of Banking and Insurance.

John M. Laird, who was assistant actuary of the Connecticut General Life Ins. Co., has been elected actuary and assistant secretary.

James D. Maddrill has been appointed actuary of the United States Bureau of Efficiency.

William N. Magoun is the manager of the Massachusetts Rating and Inspection Bureau.

Robert K. Orr, who was secretary and general manager, is now president of the Michigan Employers Casualty Co.

Stanley L. Otis is the secretary of the Insurance Federation of New York State.

Mrs. Dorothy M. Rolph, who is deputy insurance commissioner of Colorado, has also been appointed the actuary of the insurance department.

Claude E. Scattergood, who is assistant secretary of the Fidelity and Casualty Co., has also been appointed actuary of the company.

Members are requested to send to the Editor items for publication under Current Notes.

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MEMBERSHIP OF THE SOCIETY, APRIL 20, 1917.

FELLOWS.

Those marked (†) were Charter Members at date of organization, November 7, 1914.

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, Actuary, American Mutual Liability Ins. Co., 50 State St., Boston, Mass.
Apr. 20, 1917	Blanchard, Ralph H., Instructor in Insurance, Wharton School of Finance, University of Pennsylvania, Phila., Pa.
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, Massachusetts Employees Ins. Assn., 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., Statistician, State Industrial Commission, Madison, Wis.

Feb. 19, 1915	Burns, F. Highlands, 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., Treasurer, Massachusetts Employees Ins. Assn., 185 Devonshire St., Boston, Mass.
†	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., Assistant Secretary, National Automobile Underwriters Conference, 80 Maiden Lane, New York.
†	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., 819 Dime Bank Bldg., 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., Actuary, Pittsburgh Life & Trust Co., Pittsburgh, Pa.
†	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., Assistant Actuary, Equitable Life Ins. 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. B., 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, 1 Beacon St., Boston, Mass.
†	Greene, Winfield W., Special Deputy Commissioner, Dept. of Banking and Insurance, Trenton, 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, Office of Joseph Froggatt & Co., In-Insurance Accountants, 25 Church St., 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., Statistician, Prudential Ins. Co., Newark, N. J.
Oct. 22, 1915	Holland, Charles H., 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 and Assistant Secretary, 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, State Industrial Commission, 230 Fifth Ave., New York.
†	Luckett, D. G., Secretary, United States Casualty Co., 80 Maiden Lane, New York.
Feb. 19, 1915	Maddrill, James D., Actuary, U. S. Bureau of Efficiency, Washington, D. C.
†	Magoun, William N., Manager, Massachusetts Rating & Inspection Bureau, 58 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., Secretary and Actuary, Massachusetts Employees Ins. Assn., 185 Devonshire St., Boston, Mass.
†	Mullaney, Frank R., Fidelity & Casualty Co., 92 Liberty St., New York.
†	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., Secretary, Social Insurance Committee, American Medical Assn., 131 E. 23rd St., New York.
†	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., Assistant Secretary and Actuary, Fidelity & Casualty Co., 92 Liberty 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., London, Eng.
†	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.
†	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	
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. 22, 1915	Brann, Ralph M., Manager, Colorado Branch, National Workmen's Compensation Service Bureau, Denver, Col.
(1) Oct. 22, 1915	Brockway, U. H., Travelers Ins. Co., Hartford, Conn.
Oct. 22, 1915	Buffler, Louis, Jr., State Ins. Fund, 230 Fifth Ave., New York.
Oct. 22, 1915	Feder, Marcy, Assistant Examiner, New York Ins. Dept., 165 Broadway, New York.
Oct. 22, 1915	Levy, S. Leon, State Ins. Fund, 230 Fifth Ave., New York.
Oct. 27, 1916	McClure, Laurence H., Aetna Life Ins. Co., Hartford, Conn.
Oct. 22, 1915	McGuire, Vincent G., Provident Loan Society, 346 Fourth Ave., New York.
Oct. 27, 1916	McManus, R. J., Travelers Ins. Co., Hartford, Conn.
Oct. 27, 1916	Miller, Tilford W., Travelers Ins. Co., Hartford, Conn.
Oct. 22, 1915	Müller, Fritz, New York Life Ins. Co., 346 Broadway, New York.
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.
Oct. 27, 1916	Waite, A. W., Aetna Life Ins. Co., Hartford, Conn.
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, APRIL 20, 1917.

	Fellows.	Associates.	Total.
Membership, October 27, 1916	140	21	161
By Withdrawal	2	—	2
	138	21	159
Addition:			
By Election—April 20, 1917	4	—	4
Membership, April 20, 1917	142	21	163

ABSTRACT FROM THE MINUTES OF THE MEETING, APRIL 20, 1917.

The eighth regular meeting of the Casualty Actuarial and Statistical Society of America was held at the Copley-Plaza Hotel, Boston, Massachusetts, on April 20, 1917.

President Craig called the meeting to order at 10.30 A. M. The roll was called, showing the following twenty-nine Fellows and two Associates present:

FELLOWS.

BLACK	FISHER	MADDRILL
BRODIN	FLYNN	MELTZER
BUDLONG	FONDILLER	MICHELBACHER
BURHOP	GRANDFIELD	MILLIGAN
CAMMACK	HATCH	MOORE, G. D.
COGSWELL	HUNT	MOWBRAY
CRAIG, J. D.	JOHNSON	SCATTERGOOD
DEARTH	KING	WHITNEY
DOWNEY	KOPF	WOODWARD
FALLOW	LAIRD	

ASSOCIATES.

MCCLURE WAITE, H. V.

The President delivered the address printed in this number.

The minutes of the meeting held October 27 and 28, 1916, were approved as printed in the *Proceedings*.

The Council reported, among other things, that the Treasurer had been directed to invest such funds of the Society as are available, to the extent of not less than $750 and not more than $1,000, in the new United States Government War Loan; and that it recommended the appointment of a committee to consider the matter of military pensions and similar subjects and to offer the services of the Society to the Council of National Defense or other appropriate governmental authorities. The report of the Council was adopted.

The Council recommended the following four men for election to Fellowship in the Society, without examination, under the terms of Article III of the Constitution:

Blanchard, Ralph H., Instructor in Insurance, Wharton School of Finance, University of Pennsylvania, Phila., Pa.

Burhop, W. H., Statistician, State Industrial Commission, Madison, Wisconsin.

Meltzer, Marcus, Statistician, National Workmen's Compensation Service Bureau, 13 Park Row, New York.

Smith, Charles G., Assistant Actuary, New York Ins. Dept., 165 Broadway, New York.

After ballot, these nominees were declared duly elected Fellows.

The report of the Secretary-Treasurer was read and accepted.

The reports of the Committe on Examinations and Committee on Papers was adopted.

The report of the Special Committee appointed to determine the policy of the Society with reference to certain matters involving the general welfare of the Society was adopted, and upon motion it was directed that the report be printed in the *Proceedings*. The report appears below.

The papers printed in this number were read or presented.

Recess was taken until 2 P. M., during which time luncheon was served at the Copley-Plaza Hotel. Upon reconvening, the reading and presentation of papers was resumed. The papers read at the last meeting of the Society were then discussed.

Upon motion the meeting adjourned at 5.30 P.M.

REPORT OF THE SPECIAL COMMITTEE APPOINTED TO CONSIDER THE POLICY TO BE ADOPTED BY THE CASUALTY ACTUARIAL AND STATISTICAL SOCIETY OF AMERICA WITH REFERENCE TO CERTAIN MATTERS INVOLVING THE GENERAL WELFARE OF THE SOCIETY.

TO THE MEMBERS OF THE CASUALTY ACTUARIAL AND STATISTICAL SOCIETY:

The undersigned committee, appointed pursuant to a resolution of the Society adopted on October 27, 1916, presents for your consideration the following report:

It is the opinion of your committee that the usefulness of the Society is largely dependent upon action by its individual members in their individual capacity, and not in any sense as representatives of any company, department of government, or insurance organization with which they may be officially connected. It should, we believe, be emphasized in every way possible that this Society is in no way an organization of insurance companies or institutions; that it has been formed primarily for the advancement of scientific knowledge; that private or personal profit or advantage has no part in its aims; and that, as an organization, it should take no part for or against political or social propaganda, except as respects such strictly actuarial or statistical questions as may be involved.

With these thoughts in mind, the following recommendations are made:

1. That in all papers prepared for the Society there shall appear

no comparative statistics of insurance companies or organizations, presented in such a way as to lend themselves to competitive uses or construed as a criticism of any particular organization. In general, it seems desirable to eliminate the names of individual companies from the *Proceedings* as far as possible. Members are urged to confine their discussions to the technical as distinguished from the competitive aspect of all questions discussed.

2. That all business cards or advertising announcements of members of the Society shall contain no reference to connection therewith, except that the statement "Fellow (or Associate) of the Casualty Actuarial and Statistical Society of America" be permitted.

3. That in the case of all books, papers or articles written by members and independently published, or appearing in other periodicals or journals, there shall be no reference to the membership of the author in the Society, except "Fellow (or Associate) of the Casualty Actuarial and Statistical Society of America." In this connection we are of the opinion that the time has not yet arrived when it seems fitting to authorize the use of initials following the names of members. In future years, as our examination system becomes more effective and our standards of admission more stringent, it may be that the Society will wish to authorize the use of initials.

4. That on official reprints of papers from the *Proceedings* only the name of the author shall appear, and that there shall be no reference on the cover of such reprints to his business or official connections.

5. That no copies of papers prepared for presentation to the Society be furnished to newspapers or other periodicals for release prior to the date of the meeting at which such papers are to be presented.

6. That it be the policy of the Society to accept no paid advertising in the *Proceedings* of any kind whatsoever.

Many of the foregoing recommendations are not directed against existing practices, but are, rather, aimed at the prevention of conditions which, if they should arise, would, it is thought, prove prejudicial to the best interests of the Society.

FREDERICK L. HOFFMAN,
LEON S. SENIOR,
JOSEPH H. WOODWARD, *Chairman,*
Committee.

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.

EXAMINATIONS OF THE SOCIETY.

COMMITTEE ON EXAMINATIONS.

G. F. MICHELBACHER (CHAIRMAN)
CHARLES S. FORBES — EDWIN W. KOPF
BURRITT A. HUNT — JAMES D. MADDRILL

EXAMINATION FOR ENROLLMENT AS ASSOCIATE.

HELD ON MAY 2, 1917.

PART III. FIRST PAPER.

Time Allowed, Three Hours.

1. (*a*) If i and d are corresponding effective rates of interest and discount; j and f the corresponding nominal rates of interest and discount convertible m times a year; and δ and δ' the corresponding forces of interest and discount; prove that (1) $i - d = id$; (2) $j - f = jf/m$; (3) $\delta - \delta' = 0$.

(*b*) If a be the value of an annuity-certain to continue for n years, and b the value of an annuity-certain to continue for $2n$ years, find the rate of interest assumed in terms of a and b.

2. (*a*) What is (1) "cumulative error"; (2) "compensating error"?

(*b*) Define "probable error."

3. Obtain the following formulæ and give verbal explanations:

(*a*) $A_x = v - da_x$;

(*b*) $A^1_{x\overline{n}|} = v(1 - v^n_n p_x) - (1 - v)a_{x\overline{n}|}$.

4. (*a*) Define "mean deviation" of a series.

(*b*) What is "skewness"? Give Pearson's measure of skewness.

5. (*a*) Prove that in the discharge of a loan the payments of principal contained in successive equal payments made at equal intervals are in geometric ratio.

(*b*) Using the binomial theorem, compute to the nearest fourth significant figure, the nominal rate of interest convertible 52 times a year at an effective rate of 5 per cent. per annum.

6. Is the following statement true of all industries? "The cost of Workmen's Compensation is assessed in the first instance against the employer or the industry; it is then shifted to the consumer and in this way is paid by society at large." Name at least one industry for which this law does not hold and explain why it does not hold.

7. A weekly payment annuity table for compound interest of 4 per cent. per annum is computed for weekly periods up to 416 weeks, by successively adding fractional powers of v which have been determined from correct annual values on the incorrect assumption of linear variation between annual values. Calculate the error in the tabular value for 416 weeks, given $j_{52}=.03924$, $v=.96154$ and $v^8=.73069$.

8. (*a*) Give formula for the following benefit, payable momently and limited to 66⅔ in any year:

30 each year until death or remarriage of widow aged 40
25 each year until death of parent aged 65
10 each year, becoming 15 in event of widow's death, payable until age 18 to each of two children aged 12 and 15.

(*b*) Indicate how you would calculate the most complicated term in your formula, given only the necessary tables of mortality and of combined mortality and remarriage.

PART III. SECOND PAPER.

Time Allowed, Three Hours.

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9. (*a*) How would you form a table of numbers of widows living not remarried given a mortality table applicable to widows and a table of annual rates of remarriage of widows? Give formula.

(*b*) Given such a table, how would you use it to determine the present value of a benefit of $1 a week payable to a widow for 312 weeks or until prior death or remarriage?

10. Distinguish between:

(*a*) "Economic" problems and "social" problems.
(*b*) Poverty and pauperism.

11. Prove that the value of a life annuity is less than the value of an annuity-certain for the term of the curtate expectation.

12. What does the following formula represent?

$$r=\frac{\Sigma(xy)}{N\sigma_x\sigma_y}$$

Define each term. Give an example of the application of the formula to casualty insurance practice.

13. (*a*) If a population consists of l_x persons of age x, l_{x+1} of age $x+1$, and so on down to the extremity of life, show that the total fund to be raised to provide an insurance of unity on the death of each person is $l_x(a_x + A_x)$.

(*b*) Define force of mortality and derive an expression for it.

14. (*a*) Prove $A = K + (j/i)(C - K)$ by general reasoning; C being the redemption price, K the present value of C, j the ratio of annual dividend to C, i the effective rate of interest earned per annum, and A the present value of the security.

(*b*) Discuss and illustrate the applicability of this formula with or without modification to intervals other than annual and to cases where interest is convertible with different frequency from that of dividend payment.

15. (*a*) What influences affect the "marginal desirability" of money?

(*b*) State Gresham's Law.

16. The actual number of weeks in our calendar year is 52.1775. The effective rate of interest being 4 per cent. per annum, and each payment being made at the end of the week, calculate the error committed in the usual assumption of 52 weeks to the year in the valuation of a series of 312 weekly payments certain of $10 each.

Given 52d root of $1.04 = 1.000754529$ and 52.1775th root of $1.04 = 1.000752105$, and the following logarithms:

log. 104 = 2.01703334
log. 79031 = 4.897797
log. 79032 = 4.897803
log. 79094 = 4.898144
log. 79095 = 4.898149

HELD ON MAY 3, 1917.

PART IV. FIRST PAPER.

Time Allowed, Three Hours.

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1. (*a*) What are the first five important heads of the convention form of annual statement blank for miscellaneous lines of business?

(*b*) What should the total amount of ledger assets at the close of any year balance with? State the factors which prove such balance.

2. Illustrate graphically and discuss the facts shown in the following table:

NUMBER AND PERCENTAGE OF POVERTY CASES ASSIGNED TO SPECIFIED CAUSES.
Charity Organization Society of .....

Cause of Poverty.	Number of Cases.	Per cent. of Total.
Unemployment	1873	30.2
Sickness	1268	20.5
Insanity of Breadwinner	51	.8
Accident	208	3.4
Insufficient Earnings	451	7.3
Alcoholism	700	11.3
Physical Defects	525	8.4
Other Causes	1121	18.1
All Causes	6197	100.0

3. Describe briefly the general provisions of any insurance law with reference to special deposits by casualty companies. What is the practical value of these deposits in protecting policyholders in the event of liquidation of the company?

4. (*a*) Discuss the issuance of accident policies in the following cases of physical impairment: (1) diabetes; (2) hernia; (3) recent dislocation of shoulder; (4) right hand off; and of health policies in the following cases: (5) family history of insanity; (6) tonsilitis; (7) ulcer of stomach; (8) appendicitis.

(*b*) Assign to proper personal accident classification as "Ordinary," "Medium," "Preferred," "Extra Preferred," etc.: (1) city fireman; (2) physician and surgeon; (3) automobile tester on road; (4) shipping clerk not handling goods; (5) civil engineer, surveyor; (6) dancing teacher, *a*—male; *b*—female; (7) police patrolman; (8) street railroad motorman; (9) pawnbroker; (10) driver of coal wagon.

5. Discuss the following points in table structure:

(*a*) What are the characteristics of a satisfactory table heading?

(*b*) Shall vertical totals be placed at the top or bottom of columns?

(*c*) Shall horizontal totals be placed at the left or right hand side of a table?

(*d*) What is the practical advantage of placing the most recent year at the top of columns or at the left hand side of a table, having remaining years follow in a series in decreasing order?

6. (*a*) State briefly several standard provisions of accident policies.

(*b*) Draft a provision for an accident policy protecting the issuing company in event of war.

7. Explain briefly the application of "Cost Accounting" to Casualty Insurance.

8. (*a*) What is the usual extent of coverage in boiler or fly-

wheel insurance; if the total amount recoverable is limited, how is the idemnity distributed?

(*b*) State two standard exclusions common to boiler and fly-wheel insurance.

(*c*) How is the premium dollar divided, approximately, in boiler insurance?

PART IV. SECOND PAPER.

Time Allowed, Three Hours.

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9. Answer one of the following :

(*a*) Describe the International Association of Industrial Accident Boards and Commissions' classification of industries and of industrial accidents.

(*b*) What publications of the United States Bureau of the Census are of special value in the work of the casualty and social insurance statistician? Why?

(*c*) Describe one of the leading publications of the past year by the United States Bureau of Labor Statistics or by any State Bureau of Labor or Industrial Accident Statistics.

10. (*a*) Compare premium rates for insurance of plate glass for windows (1) on basement or grade floor; (2) on first floor above this; (3) on floors above these. What, in round numbers, would be a fair going rate for a window 5 ft. x 7 ft. on the grade floor?

(*b*) Discuss the issuance of plate glass insurance on the following: (1) show cases; (2) bent glass; (3) mirrors; (4) cathedral glass.

11. (*a*) Explain in detail the method of computing the "not admitted assets" under the special deposit schedule of the annual statement.

(*b*) Why are these assets disallowed?

12. (*a*) Define burglary as indemnified.

(*b*) Discuss the "permissible vacancy" provision in a residence burglary policy.

(*c*) Discuss the statistical situation with regard to rate making in burglary insurance.

13. Give an outline of any Workmen's Compensation Act with which you are familiar.

14. Sketch the form, title, box headings and stub headings for a table to show:

(*a*) Number of males unemployed, both wholly and part-time, and classified by industry and occupation of usual employment and by duration of unemployment.

(*b*) What classification of industries and occupations would you use? What are the chief features of this classification?

15. (*a*) Define accident as indemnified under ordinary personal accident policies.

(*b*) Discuss conditions in the application that void an accident policy.

16. On December 31, 1916, the books of the A. B. Insurance Company disclosed the following Accounts and Balances:

Capital	$ 500,000
Investments—Stocks and Bonds	2,000,000
Surplus	450,000
Interest	79,000
Profit and Loss a/c (Cr. Balance)	1,350,500
Accrued Interest on Stocks and Bonds	25,000
Commissions	
Cash Balance in Banks	309,500
Premiums Written	2,375,000
Losses and Loss Expenses	112,500
Salaries and Traveling	228,150
Inspections	75,000
Taxes, Licenses and Fees	37,000
General Expenses	24,165
Cash on Hand	2,165
Bad Debts—Premiums Uncollectible	685
Premiums Outstanding	402,835

From the above prepare, (1) Trial Balance, supplying the missing amount, (2) Profit and Loss Account, (3) Balance Sheet.

EXAMINATION FOR ADMISSION AS FELLOW.

HELD ON MAY 2, 1917.

PART I. FIRST PAPER.

Time Allowed, Three Hours.

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1. (*a*) Explain what is meant by the amortization of bonds.

(*b*) Give your reasons as to whether or not it is good practice for a life insurance company to value its securities on an amortized basis. Does the same reasoning apply to a Casualty Insurance Company? Why?

2. A company writing Compensation business with all its policies running for one year, observes, in making up its annual statement at the end of the year, that the business in force expires approximately evenly throughout the year except for January. It is noticed that the gross premiums upon policies expiring in January are $290,000 and that the gross premiums on policies expiring in the other eleven months are approximately $50,000 for each month. The company computes its Unearned Premium Reserve on the fifty per cent. basis. What difference would there be in the total calculated liabilities of the company if it reserved for its policies according to their actual unexpired terms, i. e., upon the so-called semi-monthly basis.

3. (*a*) Discuss the propriety of the use of the "insurable horse power" as the basis for the classification and rating of private pleasure automobiles.

(*b*) Give at least three reasons why automobile liability rates should be higher for certain territories of the United States than for others.

4. Discuss the proposed liability reserve law adopted by the Convention of Insurance Commissioners; name its principal provisions; criticize it, first, from a standpoint of application to existing business, second, from a standpoint of adequacy, and third, from a standpoint of elasticity. Does it meet the special reserve situation with which the companies are now confronted?

5. Define the following terms: (1) First Mortgage Bonds; (2) General Mortgage Bonds; (3) Collateral Trust Bonds; (4) Debentures; (5) Preferred Stock; (6) Common Stock; (7) Equipment Notes.

6. A company transacting compensation business in all of the Compensation States is called upon to estimate a reserve for its outstanding losses on this class of business at December 31, 1916, same to be filed January 15, 1917. Give three reasons why a loading should be added to the estimates.

7. Suppose a policyholder has a General Liability Policy covering a department store the premium based in part upon the wages earned by all employees (except drivers enumerated in a concurrent teams policy) and suppose that such policyholder also has a Concurrent Teams Policy the premium of which is computed upon the basis of wages paid to drivers. On a busy Saturday a man is taken from behind the counter to help a driver of one of the teams. This man is injured away from the premises by reason of the horse running away and overturning the vehicle upon which he is working and as a result of his injury he collects damages from the employer. To which policy (General Liability or Teams) should the loss be charged? Give reason for your answer.

8. Explain the difference between the so-called Schedule P and Supplementary Schedule P called for in the annual statement of companies transacting Liability and Workmen's Compensation Insurance.

PART I. SECOND PAPER.

Time Allowed, Three Hours.

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9. In computing Liability Loss Reserves, unallocated claim expenses such as witness fees, salaries and expenses of adjusters and field men, rents, stationery, etc., are included in the "Losses Paid." In your opinion should these items be included or excluded; state reasons supporting your opinion.

10. What are the two fundamental points of difference between the liability of an employer for injury suffered by his employee in the course of his employment under the rules of the Common Law and under a Workmen's Compensation Law?

11. What are index numbers? How are they constructed? Theoretically is it possible to construct an index number to show the trend of the severity of accidents in an industry over a period of years? If so, how would you proceed to establish such series of index numbers?

12. In purchasing Municipal Securities, what information should one obtain before reaching a decision?

13. Give the principal defenses available to the employer at Common Law (when not changed by statute) in a suit brought by his employee for damages on account of injury sustained in the course of his employment. State how and to what extent these defenses have been rendered unavailable by most of the Compensation Laws.

14. Discuss briefly the following questions of Experience Rating:

(*a*) Which is preferable under existing competitive conditions, Prospective or Retrospective rating?

(*b*) Are payroll and premium limitations necessary in the determination of the eligibility of a risk to be experience rated? Why?

(*c*) Do you believe it is feasible to ignore the death and total permanent disability cases in the experience of individual risks and to spread the cost of these cases over the entire industry? If so, how would you accomplish this end?

15. What in general is the difference between the accidental injuries covered by a Liability Policy and those covered by a Personal Accident Policy?

16. (*a*) Comment on the compensation of occupational disease.

(*b*) State your views on the relative desirability of covering all occupational diseases in comparison with the compensation of a list of specific diseases.

(*c*) Mention two States which compensate occupational disease. Point out in each case the provision of the Compensation Law which permits the inclusion of occupational disease.

HELD ON MAY 3, 1917.

PART II. FIRST PAPER.

Time Allowed, Three Hours.

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. Discuss briefly two of the following subjects:
   (*a*) Social Insurance and Philanthropy.
   (*b*) Social Insurance and Prevention.
   (*c*) Social Insurance and Destitution.

2. (*a*) Describe the various forms of social insurance.
(*b*) Which country has a complete social insurance scheme?
(*c*) What forms of social insurance have been adopted in the United States?
(*d*) In your opinion, is social insurance at variance with American ideals?

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*) Give a brief historical sketch of morbidity statistics.
(*b*) Describe in some detail one of the following:
   Watson's Manchester Unity Tables, 1893–1897.
   Mayet's "Ortskrankenkasse für Leipzig und Umgegend" Tables, 1887–1905.
   Bleicher's Frankfurt Tables, 1896.
   Moser's Swiss Morbidity Table.
   Billings' United States Morbidity Tables, 1880 and 1890.

4. Outline an office and field inquiry into the statistical facts

of sickness, its nature, frequency and duration during a calendar year in a State, assuming that the following opportunities for gathering data exist:

(*a*) Enumeration of the sick and the well in the general community.

(*b*) Records of hospitals, sanatoria and other medical institutions.

(*c*) Health department and accident board records, of deaths, sickness and accidents.

(*d*) Insurance experience in the prescribed area.

TOPIC 3.

SYSTEMS OF INVALIDITY, OLD AGE AND UNEMPLOYMENT INSURANCE.

5. (*a*) What are the various forms of unemployment insurance in existence?

(*b*) Discuss the relative merits of two unemployment insurance schemes.

(*c*) What bearing has the Labor Exchange on the question of unemployment insurance?

6. Outline briefly the benefit provisions of what you would term a well balanced health insurance bill.

TOPIC 4.

CALCULATION OF PREMIUMS FOR AND VALUATION OF PENSION FUNDS.

7. Derive formula in commutation symbols for the annual contribution for a sick benefit to age 65 and life annuity thereafter.

8. (*a*) What is the so-called Pension Method?

(*b*) State briefly the advantages of:

(1) The contributory system of pensions.

(2) The non-contributory system of pensions.

PART II. SECOND PAPER.

Time Allowed, Three Hours.

TOPIC 1.

PRINCIPLES AND HISTORY OF SOCIAL INSURANCE.

9. Relate the circumstances leading to and the results of the codification of the social insurance laws of Germany in 1911.

10. (*a*) Discuss the relative desirability of:

(1) A voluntary social insurance plan subsidized by the government.

(2) A compulsory social insurance plan.

(*b*) Discuss the danger of "adverse selection" in a compulsory social insurance plan.

TOPIC 2.

COMPILATION AND USE OF CENSUS OR OTHER GOVERNMENT STATISTICS RELATING TO POPULATION, MORTALITY, INVALIDITY, SICKNESS, UNEMPLOYMENT, OLD AGE AND ALLIED MATTERS.

11. (*a*) Define:

(1) Mortality.
(2) Morbidity.
(3) Morbility.
(4) Lethality.

(*b*) What statistical reasons are there for distinguishing sickness experience by (*a*) sex, (*b*) age and (*c*) occupation or industry class?

12. Given the sickness and mortality experience of insurance societies within, say, a State, how would you proceed in compiling a morbidity table for the entire State, assuming the membership of the societies to be fairly representative of the insurable population?

TOPIC 3.

SYSTEMS OF INVALIDITY, OLD AGE AND UNEMPLOYMENT INSURANCE.

13. What data would you require as the basis for an actuarial calculation of the cost of:

(*a*) Old Age pensions.
(*b*) Unemployment insurance.

14. Give a brief outline of the administration of the health insurance section of the National Insurance Act of Great Britain.

TOPIC 4.

CALCULATION OF PREMIUMS FOR AND VALUATION OF PENSION FUNDS.

15. (*a*) How would you estimate the annual cost of a pension and retirement plan providing the following benefits:

(1) An allowance for temporary or permanent disability.
(2) An allowance to dependent relatives at death.
(3) An Old Age pension.

(*b*) What interest, mortality and withdrawal rates would you assume?

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