

VOLUME II, PART I

NUMBER 4

PROCEEDINGS
OF
The Casualty
Actuarial and Statistical
Society of America

October 22 and 23, 1915

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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.

PROCEEDINGS

OCTOBER 22 AND 23, 1915.

ADDRESS OF THE PRESIDENT, I. M. RUBINOW.

In virtue of our constitution, which for reasons unknown and incomprehensible, like most constitutions, has prescribed the annual meeting to be held in October, we are assembled here today for the second annual meeting of the Casualty Actuarial and Statistical Society of America, less than a year since its organization. It behooves me as the first President of our young organization to conclude my term of service with a brief account of its accomplishments, and in weighing what I have to say I will ask you to remember that in reality the year has not yet expired and that our liveliest imagination is powerless to foretell the many great things which may be achieved within the next two weeks.

In the development of our branches of insurance, namely casualty and social insurance, this year was a fruitful, though perhaps not a revolutionary one. As for the three or four years preceding, accident compensation has held the center of the stage. In nine states and territories new compensation acts were passed* and in eight substantially amended,† disregarding changes of minor importance in many others. In most other states a very large amount of preliminary legislative work has been done in advocacy of new compensation acts, or of amendments to existing acts, which for one reason or another has not been carried to the final stage of legislative enactment. It is evident therefore that our American compensation system is still in the making. There are still seven-

* Alaska, Colorado, Hawaii, Indiana, Maine, Montana, Oklahoma, Pennsylvania and Wyoming.

† California, Connecticut, Michigan, Minnesota, New York, Oregon, West Virginia and Wyoming.

teen states which must be printed in black on various compensation maps, and it is perhaps no coincidence that most of them are in the black belt of the United States. But with Maryland and West Virginia on the north, Louisiana on the south and Texas on the western frontier, in the hands of the compensation forces, the final conquest of America by this German idea is a matter of time only.

But in all states substantial changes are also certain. Tendencies for more liberal and equitable scales of compensation, for elimination of the vicious elective system, for compulsory insurance of some kind or other, for better systems of public control of adjustments, and finally for public control of rate making, are unmistakable. In fact the development of this movement for public control of compensation insurance rates, the movement of greatest importance to us as members of the actuarial and statistical professions, is as unmistakably the most prominent feature of 1915, as was the birth of the elective system, the movement for constitutional amendments, for compulsory insurance and for state insurance experiments characteristic of the years that preceded it. By this time in New York, Pennsylvania and Massachusetts, in Maryland, Texas and Oklahoma, in Colorado, Wisconsin and California and perhaps in other states, some public control of compensation rates exists. It can scarcely be doubted that this movement once begun, and thus rapidly developed, is bound to grow.

Now as members of various insurance organizations we may have very different ideas on the subject of the desirability of such public rate control, or even public rate making. This being, as the chairman fully recognizes, a debatable question, a "land of doubt" as it were, it is perhaps best for him in strict compliance with Article II. of the Constitution, not to take partisan attitude in this matter. He is very much tempted, however, to point out at this time that out of a conference between the New York Workmen's Compensation Service Bureau and the Massachusetts Inspection Board (in both of which organizations the same companies are largely represented) has grown what is for all practical purposes a voluntary national organization for public rate making in which stock companies, private mutuals, state mutuals, state funds, state insurance departments and state industrial commissions are all represented. Whoever be held responsible for this perhaps somewhat unexpected result, whoever is to be praised or perhaps blamed for it (and I am afraid that these persons are all members of this

Society), we are facing a definite "fait accompli" which the casualty business has gracefully accepted.

Whatever the business aspects of this movement, its scientific value cannot be overestimated. As members of our profession, we cannot help welcoming it, for it has clearly brought out to the surface the great need of a special branch of insurance science which is in the making at present. It will be no news to you if I say that that branch of science is being built almost exclusively by members of our Society. We hold our meetings only three or four times a year, but whenever compensation problems are publicly discussed the roll call sounds like a committee meeting of the C. A. S. S. A.

But the participation of our organization as an organization in this work has been even more direct. There have been many meetings, conferences, and congresses of insurance men this year, perhaps more than any other year. But it is no idle boast to say, that for substantial and lasting results few of them equal in importance the three small meetings held in the quiet room at the City Club, the proceedings of which have filled three fair-sized books. The fondest hopes of the organizers did not contemplate the development of a scientific publication the first three issues of which are already recognized as classic and are being used as textbooks for class room instruction in some of our leading universities. The discussion of schedule rating last May has attracted wide attention among all insurance circles. The symposium on liability and compensation loss reserves is being studied very carefully in all insurance departments where changes of existing legislation are contemplated. Perhaps some of the papers already published and to be published, would have been written and printed anyway, in the journals of older organizations. But that the existence of this society, the necessity of holding frequent meetings has proven a strong stimulus to scientific effort, your president, your secretary and your editor know by actual experience. It is almost difficult to believe that less than a year ago the writing of scientific papers scarcely occurred to most actuaries, statisticians, and experts in casualty lines. Encouragement, persuasion and even intimidation were often necessary to prevent the meetings from becoming flat failures. Three papers were delivered at our first meeting, four at the second, seven at the third and twelve have been prepared for the present one. For the first time several papers have come unso-

licited and if the flood continues to grow at the same rate, soon some process of careful selection may become necessary. Already several papers have been printed which have not been presented at the meetings, and more frequent issue of our publication will become necessary in the near future. That for some time problems of compensation, and specifically of compensation rate making, will retain their predominating position is inevitable. But gradually the numerous problems, outlined in one of my earlier addresses, are gaining recognition. One or two papers on other lines of casualty insurance have been presented, others are in active preparation. Personal accident and health insurance, burglary insurance and other lines need as much scientific light, have as much to gain in the future, as insurance of workmen's compensation. Even towards pure theory, towards the application of higher mathematics to casualty problems our Society has not remained indifferent. Both the profound mathematician and the practical underwriter are being equally benefited by our work.

But the usefulness of the Society and its work during the very first year are not limited to the stimulus it gives to individual scientific work and the opportunity to free discussion and publication. Through its committees the collective influences of the expert and trained workers have been utilized and are felt to an advantage. The absence of a definite system of symbols places an obstacle in the way to clear writing. Our terms are frequently indefinite, and subject to different interpretation by the numerous government authorities. The Committee on Terms, Definitions and Symbols recently organized and divided into two subcommittees, one terms and definitions and the other on symbols, will eventually give us a well-defined dictionary of terms without which scientific thinking is made unnecessarily difficult and a logical system of symbols as closely approaching that of the life insurance actuaries which will facilitate friendly intercourse and interchange of ideas between all the actuarial organizations.

Perhaps the most important results have been achieved by the latest committee on Compensation Statistics, organized in compliance with the society's resolution, under the chairmanship of your president. It is unnecessary before this meeting to dwell upon the great importance of accurate and uniform compensation statistics for general social as well as special actuarial purposes. This was so well recognized that from all directions spontaneous

efforts to establish standards arose. The American Association of Labor Legislation, the National Safety Council, the Federal Department of Labor, the National Association of Workmen's Compensation Boards have all had conferences and appointed committees for this purpose. It was inevitable perhaps that in these deliberations the actuarial or broadly insurance aspects of the problem were largely disregarded. On the other hand the large stock insurance companies through their Workmen's Compensation Service Bureau and to a smaller extent the parallel organization of mutuals, both with permanent statistical committees, were approaching the problem as if its insurance aspects were the only ones that mattered. At the moment the insurance problems were undoubtedly more pressing. Business problems always are as compared with purely scientific ones. But in the long run the relative position of importance may be a reversed one.

It soon appeared that there was grave danger of confusion worse confounded arising out of these numerous incoordinate efforts. Practically the first problem reduced itself to an effort to construct a uniform classification of industries, a problem which has decades of careful scientific thought behind it—a problem which interests and concerns sociologists, economists, statisticians, organized labor, actuaries and government authorities alike, a problem upon the proper solution of which the proper development of industrial and labor statistics, life insurance, safety engineering, health conservation and the actuarial basis of compensation and sickness insurance closely depend. In all the numerous movements described members of our society were actively engaged. It was comparatively easy to select from among them a representative committee of experts, whose opinions would be respected and trusted by everyone concerned, for the purpose of combining all the independent currents into one large stream and the success of the plan was quick and complete. Without holding a single formal meeting of that committee, by correspondence, private conferences and subcommittee work, harmony was achieved. To a regular meeting of the Statistical Committee of the National Association of Workmen's Compensation Boards held in Columbus in July, your President was officially invited to represent the Society, and again last month in a small subcommittee the Association of Workmen's Compensation Boards, the Massachusetts Inspection and Rating Board and the Society cooperated. If the President at times was not quite

certain of his own identity, whether at a particular moment he spoke for the Casualty Actuarial and Statistical Society, for the Workmen's Compensation Service Bureau, for the American Association of Labor Legislation, the individual company he happens to be connected with, or for himself, other members of the subcommittee were after all in similar position, and the most significant fact was that everyone was a member of this Society. The result is a system of classification of industries which while perhaps not ideally correct is the best that present American thought could devise and one which everybody in this country either has accepted or will accept.

In the accomplishment of this result the Society may feel a justifiable pride. With this problem of classification of industries out of the way, the Committee will probably turn to a study of the best system of classifying accidents by causes and by the surgical nature of injury, by the economic nature of disability. Unless I am very much mistaken, other organizations will readily withdraw from the field in the measure in which the work of this committee will be successful. Some questions were raised in regard to possible amendments of the Standard Accident Table. Without denying some pride of authorship in it, I should be the first to welcome any necessary changes in it, provided they rest on a better foundation than the original data, and it would seem that no better fitted body can be found to study American statistical data and gradually substitute them for foreign data in the Standard Accident Table than the Compensation Statistical Committee of this Society.

Already even more ambitious plans have been advanced for a co-operative text-book on Accident Statistics to be prepared under the auspices of our Society which would give it a standing not unequal to the famous actuarial text-book of the Institute of Actuaries.

To complete the account of the various directions in which the influence of the society was felt, it is necessary to mention that the President was also called into consultation with the subcommittee on Blanks of the National Association of Insurance Commissioners when possible changes in the present Convention Casualty Blank were considered. The fact that during the very first year the Casualty Actuarial and Statistical Society was three times officially called into consultation by various state authorities clearly

indicates that similar occasions will rapidly multiply in the future. Its official voice in problems of casualty and social insurance is destined to become, if it has not yet done so, as authoritative as the voice of the Actuarial Society of America in matters of life insurance, so long as the future incumbents of the President's office will remember, what the present incumbent has kept clearly before himself and before the government authorities he was consulting with, that in speaking of the Casualty Actuarial and Statistical Society, its president is first, last and all time, only an expert and not a bureau company man, not a stock insurance or mutual insurance man or state insurance or state department or industrial commission man. In the natural course the personal affiliations and business connections of your President and other officers must necessarily vary and change, but it would be very unfortunate if these purely accidental circumstances were taken into consideration in selecting them.

In my somewhat disconnected remarks this morning, I have referred once or twice to social insurance. Except that insurance of workmen's compensation—a recognized function of casualty insurance—is really a substantial branch of social insurance, progress in other branches of social insurance matters during the last year was not conspicuous. And yet the inclusion of the phrase in our constitution a year ago was not an empty formality.

Among the more important American publications on the subject during the last year may be mentioned the Wisconsin Industrial Commission's report on Old Age Insurance and Pensions prepared by our good friend Dr. E. H. Downey, an official study of sickness insurance by Dr. Warren, of the U. S. Public Health Service, prepared for the U. S. Commission on Industrial Relations, and the Report for Sickness Insurance of the Progressive Party—all carrying a certain stamp of official or semi-official authority and proving a growing political interest in the movement.

Of private investigations, I may be pardoned for pointing out my own series of articles on "Standards of Sickness Insurance" in the *Journal of Political Economy*, while the comprehensive report on social insurance of a special committee of the American Medical Association with Dr. Alexander Lambert as chairman,* is a much

* *American Medical Association Bulletin*, Vol. 10, No. 5, May 15, 1915, pages 341-395.

more important evidence of a growing interest of the influential medical profession in social insurance.

During the year the first State Commission on Social Insurance was created in California by special statute. And whoever remembers that the first workmen's compensation commissions were created in New York, Minnesota and Wisconsin in 1909, will recognize the significance of the California move. For us as actuaries the following sentence in the California Act is of special interest:

"Said commission shall also report statistics showing the probable expense to the state of any system that it may recommend for adoption, together with any measures of its own relating to this subject that may be deemed expedient."

No stronger intimation of the growing necessity of a scientific study of social insurance problems should be necessary. It is idle to speculate as to how many bad errors might have been prevented, how much more efficient our early compensation legislation would have been if the Casualty Actuarial and Statistical Society had been organized in 1909 instead of 1914. But in matters of sickness or unemployment insurance, etc., the opportunity is ours and it is before us, always provided that we shall succeed in convincing the public that we shall approach it in a spirit of pure scientific inquiry.

Perhaps our organization five years ago would have been by necessity an empty shell, for the kernel—a body of trained men—would have been lacking. Even now the number of trained men in our branch of insurance is not large. In fact ours was yet one of the few professions where the supply is hardly up to the demand. With an altruism almost incredible in this practical age, our Society has opened a campaign for the training of our future competitors. There is after all no other meaning to the system of examinations inaugurated a few weeks ago. Before the examinations were announced a good deal of mystery seemed to exist as to what constituted the necessary training of a casualty actuary. After the questions were made public there had been, I believe, some criticism that they were made too difficult and might have resulted from the desire of those on the inside to keep out those less fortunate fellows who are still outside. Whether the program is too exacting, whether the questions were too difficult, is something for the Council and the Examination Committee to consider. The

experimental character of the first examination is fully recognized and no one need feel heartbroken or discouraged for failure to pass this examination, which each charter member is silently congratulating himself on having escaped. But I beg to submit that the interpretation given is a very illogical one, in fact it is the exact reverse of the truth. A mere vote of admission, whether by council or society itself, is impotent to make the expert statistician or actuary. We might vote in even all file and copy boys of the insurance companies into the Society, without creating a single competitor to ourselves. But the fact that over thirty young men or women were forced to turn to casualty literature for a few weeks, and that soon hundreds of them will be burning midnight oil over books of insurance, mathematics, statistics and law, will undoubtedly result in a rapid increase of men able to cope with the complicated problems which confront us.

Turn whatever direction we will, the vista before us is imposing. As a scientific organization we are really in particularly fortunate position to possess such a vast virgin field so anxiously waiting to be explored and exploited. The beginnings made within a very short time are very substantial. I feel that I may speak for all the officers and the council when I say that we close the first administration with the feeling of satisfaction of work fairly well done. Perhaps few of the members really appreciate how much of it there was to be done. To mention only a few of the more conspicuous lines of activity, magazines do not publish themselves, nor can examination programs be prepared without a good deal of work. At the risk of being accused of bad taste in singling out individuals for special mention I cannot help referring to the splendid effort and devotion of our first editor, who unfortunately is not present today and the equal devotion of our editor pro tem. who volunteered to assume the work where his predecessor was forced to abandon it, notwithstanding his other duties as chairman of the Examination Committee. Perhaps the President is the only one who is fully aware of the amount of work the publication of the *Proceedings* required. Other officers and members of committees invariably assumed their duties with a good will and enthusiasm almost unprecedented in view of complex obligations which most of us are under. This splendid spirit augurs well for the future development of our Society and our profession. May it continue in all its strength and unpolluted.

THE CLASSIFICATION OF INDUSTRIES FOR WORKMEN'S COMPENSATION INSURANCE.*

BY

E. H. DOWNEY.

The existing "casualty" insurance classification† of industries is a relict of employers' liability. It grew out of the exigencies of competitive underwriting and its growth has been conditioned at every stage by the convenience of insurance solicitors. By reason of this genesis it is not adapted to the broader needs of compensation insurance; it is a thing of shreds and patches; it was never conceived as a whole nor based upon any reasoned principle of taxonomy.

So far as any consistent principle can be traced in the present manuals, it is that the entrepreneurial establishment shall be treated as a unit. Certain occupations, as office work and teaming, are segregated; but all other employments in the same plant are lumped together. Operations so diverse as wire drawing and piano finishing, beer brewing and cooperage manufacture, underground mining and brick making, are covered at one rate. Flat rates undeniably are preferred by employers and they are a great convenience to agents and auditors. The point of present interest, however, is that flat rates, under the pressure of competition, have produced an enormous multiplicity of classifications. Logically, indeed, the principle should work out to a separate risk class for every distinguishable business, trade or calling, and for every marketable commodity that is or may be produced as a separate enterprise. Competing insurers seize upon any real or supposed difference between related lines of work or production and make it the basis of a new classification at a slightly lower rate. Even apart from rate reductions, specific classifications are a selling advantage. An em-

* For helpful criticisms of this paper the writer is indebted to Dr. I. M. Rubinow of the Ocean, to S. B. Black of the American Mutual, and to W. H. Burhap and M. E. Snyder of the Industrial Commission of Wisconsin.

† The classification primarily had in mind is that of the "Bureau." Practically there is no other classification, though there are individual departures from, or modifications of, Bureau classifications.

ployer, it has been found, would rather pay \$1.79 as a manufacturer of acetylene gas machines than be placed under the more general designation of machine shop and foundry at the same rate.

In pursuance of these salesmanlike principles, bedsteads and chairs have been differentiated from furniture, cloaks (*sic* ladies' suits and coats), cloth caps, collars and cuffs, furnishings, fur goods and shirts have been distinguished from clothing, and machinery manufacturing has been subdivided into a hundred or more branches. The varying integration and division of processes contributing to the same ultimate product introduces further complications. On the flat rate principle every such variation necessitates a new risk class: gasolene engine manufacturing with and without foundry, brick making including underground mining and brick making without underground mining, brush manufacturing, assembling only, and brush manufacturing including wood working. The aggregation of unrelated lines of production under one management is treated in the same manner, producing such miscellanies as military goods, which presumably range from brass buttons to lyddite shells and from cloth working to heavy ordnance manufacture.

Of the making of classifications by this easy method there is no end. The number of distinguishable commodities is indefinitely large and the possible permutations among them approach infinity. The manual makers have by no means fully grasped their opportunities. In all consistency, brewers' machinery, paper-making machinery, tanning machinery and wood-working machinery ought to rank with boot and shoe machinery, confectioners' machinery and textile machinery.* Overalls are as distinct from other clothing as are shirts and the ladies' waist industry is hardly second in importance to the cloak trade. Illustrations might be multiplied *ad libitum*. A very little ingenuity would evolve 3,000 risk classes as distinct, and industrially as significant, as most of those in the present manual.

The indivisibility of the establishment is perhaps the only general principle of classification observable in the manual, and even this principle is cast to the winds in the construction industry. The three broad divisions of grading and excavating, erecting, and in-

* Specific classifications for "paper-making machinery manufacturing," "woodworking machinery manufacturing" and even "lathe manufacturing" have actually been filed with the Industrial Commission of Wisconsin, though of course rejected as discriminatory.

terior finishing and equipping, are subdivided by occupations and these are again cross classified by height or depth of excavation or construction,* by materials or machinery employed,† and even by the destined use or occupancy of the structure.‡ Wherefore a \$10,000 payroll may be, and often is, divided among a dozen or more risk classes at as many different rates. Indeed, a single employe may combine several classifications within his individual self. A handy man in a retail hardware store is rated at \$.42 when he sells a gas stove and at \$1.12 when he sets it up, at \$1.18 when he cuts a lead trough and at \$5.32 when he installs it.§ Some dialectical subtlety is required to reconcile the principle which lumps an iron foundry and a paper box factory at one common rate with that which distinguishes wood stair building from interior carpentry.

Many curious anomalies result from this juxtaposition of opposed classificatory theories—if, indeed, the term theory may be applied to practices which appear to rest upon no reasoned basis. On the one hand we have such inclusive classifications as creamery supplies,|| which comprise machinery, butter tubs, paper cartons and coloring extract; on the other, such hair-splitting distinctions as that between the construction and waterproofing of concrete foundations, both of which are commonly performed by one gang of laborers at one continuous operation. At the one extreme we are invited to combine the accident experience of workers in wood, metal, glass, rubber and clay; ** at the other, we are expected to separate the several occupations engaged in by the same individual in the course of a day's work. That amid such a medley of contradictions, rate differences occur which bear no relation to the hazards involved, need occasion no surprise. But the uninitiated are scarcely prepared to learn that the hazard of digging a six-foot trench and laying a pipe therein is doubled if sewage rather than water is to flow through the trench; †† that the hazard of a retail

* E. g., sewer building, maximum depth not over 7 feet; contractors, building three story residences, etc.

† E. g., railroad construction, with steam shovel, dredging by suction dredges.

‡ E. g., private residences, not mercantile or manufacturing premises; concrete construction, not grain elevators.

§ References are to Wisconsin Bureau rates in effect June 1, 1915.

|| E. g., creamery supplies manufacturing.

** E. g., electric apparatus manufacturing.

†† The distinction appears to be that a watermain is a pipe in the bottom of a trench whereas a sewer is a trench with a pipe at the bottom.

book store is greater than that of a retail grocery, or that the rate for (traction) road roller manufacturing is higher by some 65 per cent. than that for traction engine manufacturing.

Some of the worst anomalies in the compensation manual recently have been removed. A number of miscellanies have been distributed to their several components and certain industry subdivisions have been consolidated.* But these reforms, however desirable in themselves, do not touch the root of the matter. The decisive objection to the existing classification goes to the very basis upon which it is built up. The present manual—always excepting the “contractors’ schedule”—is essentially a classification of business enterprises with respect to the commodities which they produce or sell. Such a commodity classification is fundamentally incapable of meeting the primary requirements of compensation insurance.

These requirements are: (1) That each risk class shall afford a sufficient exposure for sound rate making, and (2) that the resultant rates shall secure an equitable distribution of insurance cost. The existing classification fails in both particulars.

(1) Soundness of compensation insurance rates implies something more than adequacy. Rates must be adequate, of course, but it is almost equally important that they shall not exceed the legitimate costs of insurance and that they shall not fluctuate extremely from year to year.† Opinions may differ as to the minimum exposure indicated by these desiderata but it certainly should be so large that a single injury—say a death or a permanent total disability—will not seriously affect insurance rates. Provisionally, the minimum exposure may be taken to be such that a single death will not affect the pure premium by more than one per cent.‡ Under the Wisconsin Compensation Act this would mean a payroll of \$10,-

* The Bureau basis manual is decidedly superior in these particulars to any of its predecessors. Some of the recent and more drastic reforms, however, were brought about by the mandatory rulings of the Massachusetts and New York Insurance Departments and the Industrial Commission of Wisconsin.

† Cf. Dr. I. M. Rubinow, in *Proceedings of the Casualty Actuarial and Statistical Society of America*, Vol. I, p. 146 ff.

‡ Compare A. H. Mowbray, in *Proceedings of the Casualty Actuarial and Statistical Society of America*, Vol. I, pp. 24-30; also Dr. I. M. Rubinow, *ibid.*, pp. 12, 13.

000,000 for a class on which the pure premium is \$3.00* and a correspondingly larger payroll for the less hazardous classifications. Under the New York law, owing to the more adequate death benefit, a still larger exposure is needed. More concretely, it may be said that a payroll of \$20,000,000 would represent a reasonably adequate exposure on saw mills under the Wisconsin act and that, say, \$25,000,000 would be required for the same industry in New York.† Assuming an annual payroll of \$5,000,000 in each state, the requisite exposure would be obtained in four and five years' time, respectively. This period may be shortened by combining the experience of several states, in the method employed by the Bureau manual committee.

The point deserves emphasis, however, because it has sometimes been overlooked, that there are somewhat narrow limits of time and space within which exposures are comparable. Technology, and consequently the hazards of industry, change so rapidly that accident experience is quickly antiquated. In such an industry as packers' can manufacturing, e. g., the safety propaganda and the introduction of automatic processes have nearly eliminated the once dreaded stamping hazard.‡ A recently patented device bids fair to tame the barbarous corner staying machine. The drum barker has removed an important source of danger in paper mills equipped therewith. These are typical illustrations and they go to show a high rate of obsolescence in pure premium experience. A decade is perhaps the extreme limit of reliable pure premium accumulation.§

* The maximum death benefit under the Wisconsin Act is \$3,000, or \$.30 on a payroll of \$1,000,000. The mere chance that 4 out of 9 men killed in the Wisconsin zinc mines were without dependents reduced the pure premium on \$1,500,000 of payroll by \$.80, or more than one fourth. The rare chance of third party liability for the one fatal accident to a clerical office employe affected the pure premium on a payroll of \$20,000,000 by 150 per cent.

† The pure premium under the New York act should be greater than that under the Wisconsin act in the ratio of approximately 150:100, but death benefits should be a decidedly larger proportion of the total.

‡ In one large Wisconsin plant, two years' experience shows a pure premium of \$.30 as against the Bureau base rate of \$5.60. The experience of the largest similar plant in the United States shows a still smaller cost as compared with a still higher insurance rate.

§ The preference is to accident rate and gravity. On such points as deferred mortality, remarriage and the development of latent disabilities, a much longer period of accumulation is both feasible and necessary.

Local variations are of less importance in the aggregate, because they affect a narrower range of industries, but their influence is sometimes very great. No underwriter would care to base the rate for coal mining in Colorado upon Iowa experience nor could the logging rate for the State of Washington safely be derived from Wisconsin experience. Even so thoroughly standardized an industry as boot and shoe making differs considerably in hazard as between New England and the Middle West.* Lastly, it is to be observed that even law differentials contain large elements of uncertainty. The decisions of courts and commissions, and still more the general spirit of administration, may give very different effects to similar statutory provisions.† Great caution must be used, therefore, in combining pure premium experience under different laws. As to the combined pure premium of a long term of years, under different compensation acts and in widely separated localities, the factors of disturbance are so numerous and so potent, that the aggregate result must be utterly untrustworthy.‡

In the face of these limitations, what are the prospects for sound rate making with the existing industry classification? The compiled experience of Massachusetts on some \$800,000,000 of payroll indicates that five years' time will give an adequate exposure for about thirty of the 1,500 manual classifications. Wisconsin, in the same length of time, should accumulate a sufficient experience for some ten or fifteen risk classes. New York, with its enormous and highly diversified industry, should fare much better, yet it needs no prophet to foretell that even New York State will fail to obtain a dependable pure premium on more than a small minority of the present risk classes. Some relief from this situation can be obtained by combining the experience of different states on those

* The difference appears to consist, not in machinery or processes, but in the proportion of experienced workmen—experienced in the particular place of employment as well as in the industry at large.

† A notable instance is the judicial extension of the Massachusetts act to cover occupational diseases. In Wisconsin it still is a moot point whether the specific indemnity period for certain enumerated injuries runs from the date of the accident or from the termination of temporary total disability. A substantial difference in the total cost of the act hinges upon this point.

‡ The writer does not wish to minimize the importance of combining the experience of different states—which he believes to be absolutely necessary—but only to emphasize the limitations thereof.

classes as to which local variations are unimportant. But a decade's experience of the United States would show a pitifully inadequate exposure for such classifications as blasting, chimney building, eyelet manufacturing, stairbuilding, suspender manufacturing, including metal parts, vending machine manufacturing, and many more of like industrial significance. For the great majority of the existing classifications, indeed, there is no escape from conjectural rate-making. The use of imputed pure premiums, derived from a standard distribution of accidents, is doubtless an advance over sheer underwriter's judgment, but it is far from being an acceptable substitute for actual experience upon an adequate exposure.

(2) The existing manual is equally unsatisfactory from the standpoint of equitable rates. It applies the same rate to establishments which have little similarity in kind and degree of hazard and it applies widely different rates to identical operations. Some of these inequalities are doubtless due to inadvertence or to insufficient experience, but many of them inhere in the very basis of classification. The manual, in fact, presupposes a high degree of correlation between product and hazard—a correlation which does not exist in industrial practice.

(a) The number and character of operations, and consequently the kind and degree of hazard, differ widely as between establishments turning out the same finished product. Most automobile manufacturers, e. g., buy their frames and many buy their bodies and engines as well, but a few concerns make all of these parts in their own plants. It results that one manufacturer pays a rate of \$2.35* on frame manufacturing, \$1.74 on body manufacturing, \$1.12 on engine manufacturing and \$.95 on the manufacture of other parts, including assembling and finishing, whereas his competitor pays a flat rate of \$.95 upon all these operations. The total insurance cost of the finished commodity is evidently greater when the production is divided among several establishments than when it is combined under one management.

(b) There is a still greater range of variation in those classes which embrace, not individual products, but entire commercial lines. Agricultural machinery is a case point. Both in trade parlance and in the manual classification the term covers a wide range, from cream separators to threshing machines. A few large firms manu-

* References are to Wisconsin Bureau base rates.

facture a complete line of farm implements and so have given rise to the inclusive classification. But there are also many specialty plants, producing plows, mowers, hay tools, litter carriers, or ensilage feed cutters, as the case may be. Hence an agricultural machinery plant may be purely metal working or principally wood working; it may comprise a gray iron foundry, malleable foundry, steam and drop forge shop, oxy-acetylene welding department and planing mill or may be little more than a machine shop; it may use a ten-ton crane for the assembling of individual products or may turn out nothing heavier than two hundred pounds in weight. A flat rate for the whole class is about as equitable as a flat rate for stove founding and boiler making.

(c) The same equipment and the same working personnel, in the same establishment, may simultaneously produce a variety of commodities assignable to distinct manual classifications at widely different rates. A very large employer in Wisconsin manufactures road rollers (rate \$2.97), threshing machines (rate \$1.79) and automobiles (rate \$.95). The same foundry, the same woodworking shop, the same forge shop and the same machine shop are used for all these products. Separate payrolls are kept for cost accounting purposes, but there is no physical separation of hazards so that separate rates would be an absurdity. Boilers (rate \$2.94), mining machinery (rate \$2.96) and gasolene engines (rate \$1.79); carriages (rate \$.92) and chairs (rate \$1.12); windmills (rate \$2.10) and pumps (rate \$1.79), are other instances of inseparable combinations in large establishments.

The only remedy for these inequalities, consonant with the present manual, is a further multiplication of classifications. We should have automobile manufacturing, no body or frame manufacturing; automobile manufacturing, including body manufacturing, no frame manufacturing; automobile manufacturing, including body and frame manufacturing; ensilage feed cutter manufacturing; hay tool manufacturing; plow manufacturing, and so on *ad nauseam*. Even then it would be necessary to apply special average rates to particular establishments presenting unusual combinations.

In fine, the classification of compensation risks is involved in a vicious circle. Under the rule of establishment unity, differences of operative procedure can be allowed for only by the expedient of separate risk classes; whereupon competition multiplies the number

of risk classes beyond all possibility of obtaining adequate exposures for sound rate-making. From this impasse there appears to be no escape save by adopting a new basis of classification. Two such bases readily suggest themselves; the industry group and the fundamental operative procedure.

The industry group, as a basis of risk classification, is familiar to all students of European experience. The immense and varied industries of the German Empire, e. g., are comprised by some thirty-five risk groups.* On the same basis, a hundred classes should suffice for the industries of the United States. The superiority of such a group classification in amplitude of exposure and consequent stability of rates is not to be gainsaid. It has, besides, all the advantages which can be claimed for flat establishment rates. The common objection on the score of inequity is, for the most part, a misconception. That every commodity shall bear its specific accident cost and every consumer pay his exact quota of the total is neither practically attainable nor especially important.† It is not a serious evil that the users of household furniture pay a part of the accident cost of interior trim manufacturing. Accident cost in any case is but a minor element in retail price. Moreover, consumers do not specialize in particular commodities. What a given family loses in the price of furniture may be made up in the cost of flooring. The prime desideratum is that the cost of work accidents shall be distributed over the whole community and the prime requisite to this end is that competing entrepreneurs shall be placed upon an equal footing. If all furniture manufacturers pay the same insurance rates, albeit somewhat more than would be required by their own industry alone, all are able to shift the burden upon the consuming public. But inequality as between competing employers is, in so far, a failure of distribution. Judged by this

* Not counting territorial subdivisions. The number of risk grades, however, apart from merit rating, is somewhat greater, so that the comparison with American compensation manuals is not altogether legitimate.

† This passage may appear inconsistent with what is said in an earlier section (pp. 15 and 16) on the inequality of American insurance rates. The former passage, however, deals with inequality as between competing entrepreneurs, the latter with inequality as between commodities or consumers. The entrepreneur does specialize in specific commodities and to him it is not a matter of indifference that competitors enjoy lower insurance rates, since he can not shift the excess upon consumers.

criterion, the German group system is probably more equitable than any classification in use in this country.

The substantial objection to a group classification springs from a quite different source—the competitive organization of insurance. The advantages of the system depend upon including in each group a considerable number of industries, the specific hazards of which will necessarily depart more or less widely from the group average. If, therefore, one insurer applies a level rate to the group, a competitor, by offering lower rates on the least hazardous members, may take away the cream of the business. On this rock has split every attempt by competing insurers to achieve a rational grouping of risk classes.

The most recent, as also the most promising, of these attempts is embodied in the rate-groups* of the Bureau Basis Manual. It is perhaps supererogatory to observe that a rate group is composed, not of all the industries which chance to bear the same rate, but of those only which are presumed to be similar in both kind and degree of hazard. Three such groups, all taken from the metal schedule, may be put in illustration: the tool and hardware group (Wisconsin rate \$.84), the foundry-and-machine-shop group (Wisconsin rate \$1.79) and the heavy machinery group (Wisconsin rate \$2.96). The first of these groups comprises builders' hardware, carpenters' and other hand tools, horseshoes, scales and other like products. The foundry-and-machine-shop group covers most branches of machinery manufacturing, while the heavy machinery group includes boilers, electric cranes, mining machinery, road rollers and steam shovels and dredges. None of the foregoing groups is delimited by clearly defined lines, whether of trade organization or operative hazard. Thus the tool and hardware group does not include plumbers' fittings, bolts, nuts or nails, all of which apparently fall within the category of builders' hardware, consid-

* To be distinguished from the code-groups, which latter are based on character of product rather than degree of hazard. So far as the writer is informed, the rate groups actually used by the Bureau Manual Committee have not been made public. The constituents of the principal groups can, however, be determined by necessary inference. It is not conceivable that the individual pure premiums of a dozen risk classes should be so nearly identical as to produce the identical base rate of \$1.79. Either the pure premiums were averaged to produce a group pure premium or the actual pure premium of the leading member was imputed to the entire group.

ered as a risk group, whereas it does include the manufacture of railroad car scales which would seem to belong rather with the machine-shop-and-foundry group. Yet more anomalous is the exception of hundred-ton locomotives and ten thousand horse power turbines from the heavy machinery class. The general machine-shop-and-foundry group shows equally curious exceptions. On the one hand, wheelbarrows and windmills are ranked with locomotives; on the other hand, boot and shoe machinery, textile machinery and printing presses are rated even lower than hand tools. If it be assumed that the rate groups were based upon similarity of hazard, it is plain that they have been strongly and erratically modified by competitive considerations. Still further disintegration is threatened by the action of non-Bureau companies in making exceptions not heretofore recognized by the Bureau.* In short, the Bureau's grouping system was neither consistent nor thorough-going at the outset and the pressure of competition tends constantly in the direction of greater inconsistency.

The other proposed basis of classification is less familiar—so much so indeed that its very terminology is wholly unsettled. What is had in mind is not the multitudinous and shifting occupations of individual workmen,† but those fundamental and relatively standardized industry divisions which are commonly recognized as distinct departments of the individual establishment. It appears possible to resolve all manufacturing industries into a comparatively small number of such fundamental operations or processes. Thus founding (in its several kinds, brass, malleable, gray iron and steel), machining (machine shop work), forging, boilermaking, woodworking, pattern making, painting and assembling, are well-known and fundamental processes which together make up the machinery manufacturing industry. Sawing and barking, sulphite pulp making, pulp grinding, and papermaking similarly constitute the pulp and paper industry. In like manner, the textile and clothworking trades may be resolved into carding, fulling, spinning, weaving, bleaching, dyeing and finishing, knitting and sewing. The processes enumerated are fundamental in that each is common to the production of many specific commodities and is at the same

* See, e. g., note 2.

† The writer has sometimes been understood as advocating an occupational classification. On the contrary, he believes such a classification, as a basis of compensation insurance rates, to be wholly impracticable.

time relatively uniform and standardized within itself. The hazard of a gray iron foundry, e. g., is much the same whether the factory product be gasolene engines, windmills, dynamos, or aeroplanes, The sewing hazard is essentially identical in the manufacture of burlap bags, ladies' cloaks and workingmen's overalls. Illustrations might be multiplied but those already given will perhaps suffice to elucidate the principle.

The adoption of a classification upon this principle would at once remove many of the difficulties which now confront the makers of manuals. It would secure an adequate exposure, for it would bring together the entire experience of operations which now are divided among many specific classifications. It would enable the collection of pure statistical experience, for it would separate unlike hazards which now are so frequently combined. Lastly, it would automatically adjust the rate of each establishment to the actual hazards thereof. The automobile manufacturer who does much assembling and little manufacturing would pay the assembling rate upon a correspondingly large proportion of his payroll. The agricultural implement maker who has neither a foundry nor a wood working department would be equitably treated as compared with a competitor who operates both and the manufacturer of kitchen chairs would pay a higher rate than the manufacturer of upholstered couches.*

To an operational classification may be objected that it is a radical departure from existing practice and that it would require the subdivision of payroll in numerous establishments now covered by flat rates. The establishment classification has been long in use. It has struck deep roots in the customs and habits of thought, not only of underwriters but of employers as well. An immense structure of tradition and experience has been built upon it. It is not, therefore, to be discarded lightly nor on merely academic grounds. This objection, nevertheless, is evidently not decisive if it can be shown that the long term advantages of the innovation will outweigh the temporary inconvenience. The second objection is much less serious. The additional bookkeeping trouble, whether to employer or insurer, is not of great moment. Most employers can and do, already, keep payroll accounts by departments. It has been urged, indeed, that subdivision tempts the employer to pad his

* Singularly enough, the reverse is now the case.

payroll in the low-rated, at the expense of the higher-rated, classifications. But there appears no good reason to believe that this species of fraud would prove either more attractive or harder to control than the understatement of total payroll under the flat rate system.

If the foregoing argument is well taken the existing industry classification must be reconstructed before compensation insurance can be placed upon a scientific basis. Either an industry-group or an operational classification would apparently meet the fundamental requirements of the case. It is unlikely, however, that either of these principles will be accepted in its entirety. The necessary reconstruction probably will take the form of a series of compromises between differing, but not irreconcilable, views. There are doubtless industries which are sufficiently standardized to justify flat establishment rates and sufficiently large to stand upon their own feet in the matter of accident insurance.* There are other industries which are so nearly and obviously related in point of hazard that the grouping system could be applied without much protest from any one.† But a flat establishment rate upon a specific industry classification is inequitable wherever establishments turning out the same product differ markedly in operational hazard.‡

Moreover a grouping system after the German model which should combine industries of widely different hazards would encounter strong opposition from employers accustomed to specific rates. In respect to many industries, therefore, an operational subdivision would appear to be the most satisfactory solution. Fortunately all three principles find some acceptance in present insurance practice. It should not be very difficult to determine the limits within which each is properly applicable.

Obviously, however, the task is not a simple one. To work out a classification which shall be at all adequate to the purpose will need the co-operation of underwriters, statisticians and technolo-

* Cereal milling is perhaps as good an illustration as any.

† The manufacture of adding machines, comptometers and typewriters is a case in point.

‡ Operational hazard throughout this paper is taken to mean the inherent hazard of a given fundamental operation—e. g., pulp wood grinding—as distinguished from those hazards of which merit rating takes account.

gists. It will need, also, a high degree of openmindedness, of willingness to try experiments and to hold fast that which is good. Not least of all, it will need the sanction of governmental authority. No group of private insurers, however earnest or intelligent, can establish a scientific risk classification in the face of unscrupulous competition. Just as competitive pressure has disintegrated well-marked industry groups, so it would resolve operative departments into a hopeless muddle of individual occupations. Whatever may be true of competition in service, or even in rates, competition in misclassification is an unmixed evil. Not only does it open a wide door to discrimination and to every form of unfair competition; it vitiates that statistical experience which is the foundation of all sound insurance rate making.* Every consideration of public policy, as also every legitimate insurance interest, requires uniformity of risk classification and of the rules governing payroll division. Nothing in past or present experience justifies a hope that such uniformity can be brought about by voluntary agreement.

Strangely enough, the greatest obstacle to such a reform as is here suggested is the opposition of insurance carriers. The deplorable fact is that liability insurance in the United States has never been conducted upon a scientific or even upon a healthy business basis. The immediate root of the evil appears to be the dependence upon an investment, rather than an underwriting profit. The causes of this untoward development do not concern the present inquiry. The fact is noted only because of one unfortunate result: that liability insurers have devoted their chief energies to securing a large volume of premiums and have given all too little heed to the scientific foundations of their business. Even now it is the entrepreneurs, and not the technical experts, who are privileged to speak with the voice of authority. Whence it happens that the

* Already we have seen attempts to classify as clerical office employes the markers and assorters of laundries, the packers and shippers of a chemical factory and the attendants of an electrical equipment store. Indeed, the reports of audited experience on Wisconsin compensation policies issued in 1913 show a most amazing want of uniformity in classification on the part of both Bureau and non-Bureau companies. Choice gems are the classification of an agate and enamel ware factory as "enamelling," of a harness factory as "leather novelties manufacturing," of a horse blanket factory as "clothing manufacturing," and of an automobile frame manufacturer as "automobile manufacturing." All but one of the misclassifications here cited were by members of the Bureau.

liability companies approach the question of risk classification, first of all, from the standpoint of selling advantage. Viewed from this standpoint, a radical revision of the manual is but a weariness to the flesh.

The time is at hand, however, for a diligent searching of hearts. The shadow of state or mutual monopoly looms large upon the horizon. If private insurers would remain in the compensation field they must establish themselves anew in the public confidence. Probably no one thing has done more to discredit their methods than their confessed uncertainty as to both rates and classifications. That liability experience would not afford a sufficient basis for compensation insurance rates was inevitable. But the *relative* hazards of industry were not fundamentally altered by a change in statutory liability for accidents. It was fairly to be expected that insurance companies, out of a quarter-century's experience, would have evolved a reasonably stable classification of long-established industries and reasonably dependable risk factors for each. Instead, we find a constant shifting, not alone of absolute, but as well of relative rates, together with a never-ending division and recombination of risk classes. Malleable foundries have been rated with gray iron foundries, then with machine shops, then at a point between the two; ensilage cutter manufacturing has been shifted from the heavy machinery to the machine-shop-with-foundry and lastly to the machine-shop-without-foundry group, all within a twelve-month; the classification of gasoline engine manufacturing has been changed three times within the term of one annual policy. The like illustrations might be multiplied through a list that it were tedious to recite. In the face of such evident confusion the layman loses all confidence in insurance rates. His scepticism offers a favorable soil for the growth of mushroom insurance organizations, with resulting disastrous demoralization of rates. Not even an adequate rate law will wholly remedy this situation for adequate rates cannot be determined without adequate exposures and adequate exposures cannot be had without a radical revision of the existing risk classification.

ORAL DISCUSSION.

MR. MOWBRAY: Dr. Downey's paper is of first importance because it raises for our consideration, questions regarding the fundamentals of the compensation business which should receive thorough

study not only by casualty actuaries, but by managers and underwriters of all companies.

Among the questions raised by the paper, are the following:

1. Is the present system of classifying compensation risks satisfactory or even justifiable?
2. What other systems are available?
3. Are they better than the present system?
4. Can they be substituted for it?

Dr. Downey answers the first question with an emphatic negative, at least from the actuarial point of view, and believes the same answer will be forthcoming from the thoughtful employer. He does not attempt to answer for the agent but several remarks indicate he thinks the present classification system though based on "salesmanlike principles" is a failure even from this point of view.

He mentions two other systems as possible substitutes but dismisses the first, the industry group system, as unsuited to competitive conditions. The other, based upon the process hazard notion, he discusses more fully. He believes both systems superior to that now in use.

The analysis underlying Dr. Downey's suggestions seems to be about as follows:

1. The basis for rate differentiation is difference in hazard producing a difference in insurance cost.
2. In general this does not follow product but process.
3. Therefore a system of classification based upon product will be unsatisfactory.

The crux in this reasoning lies in the second proposition. My own study of classifications and grouping of classifications tends to confirm its soundness. Dr. Downey, however, does not resort to *a priori* reasoning to establish this point, but cites many examples of misfits in the present system.

4. Since process or operation is the element on which hazard generally depends this is the best basis for classification.

With this reasoning I am in thorough accord. The difficult question to answer is the fourth. To suddenly abandon the present system and adopt Dr. Downey's suggestion would be so violent a change, that the resultant upheaval might almost be described as an "earthquake," and even if the change be accomplished gradually, there are some who will maintain the division of pay roll called for, will render the system impractical. While some consideration must be given these objections I do not believe they are so serious as to prevent the use of the system. We would, perhaps, have to have a bit higher grade talent in our auditing departments. We might for a time have to be on our guard against trickiness in division of pay roll for underwriting purposes. But there are plenty of industries now where pay roll division, optional or required, for less logical reasons presents the same difficulties.

The serious difficulty seems to be the transition, for while criticizing the present system unsparingly even Dr. Downey admits "it has struck deep roots in the customs and habits of thought, not only of underwriters, but of employers as well." I have not had sufficient opportunity to study the question to feel justified in proposing a definite program to this end. It would seem however that requirement of division of pay roll for different operations where it is now optional and amalgamation of classifications where the hazard is essentially the same, would be steps in the right direction.

MR. BLACK: Mr. Forbes proposes a method for obtaining an average rate for each employer which will reflect the various processes used and the proportion thereof. Dr. Downey proposes a brand-new industry classification based on fundamental processes involved. He does not seek to produce an average rate for the employer, but would give to the payroll expended on each process its proper rate. Because the processes determine the hazard, a process classification with rates on each process will produce equitable rates between employers. On the other hand, the formula method, by determining the relative proportions of various processes in plants of the same class, would produce an average rate for all plants of that class. For particular plants which vary from the average, rates would be produced which would reflect this variation.

The formula is proposed particularly for the handling of "Container Manufacturing" as a side-line of the principal products of a plant. The manual rate would be an average rate based on the average amount of payroll expended in container manufacturing and the governing classification for all plants of that class. A plant having a smaller proportion than the average of container payroll (if a rate for the particular kind of container is higher than the rate for the governing classification) would obtain a lower rate than the average such plant, and vice versa.

Through a process classification as explained by Dr. Downey the payroll expended in the manufacturing of containers would take the manual rate applicable thereto.

An equitable rate would theoretically be produced in both cases. The weakness of Mr. Forbes's method is that in the formula which he would apply to a particular plant he uses quantities which are tremendously variable. The rating received would depend upon the number of workers employed in the container manufacturing department at the particular time that the inspection was made for rating purposes. It is well known that aside from the very largest plants it is quite the custom to manufacture containers, or a large part of the total number used, during slack seasons in the regular work. Thus from day to day or from season to season there would be a big variation in the number of people employed in the container department as compared with the department where the regular work is done. Thus upon the information obtained by an inspector before the policy goes into effect will be determined the

rate for the entire plant. It is conceivable that there would be a fluctuation of fifty per cent. from season to season in the proportion of payrolls expended in the various departments. Obviously this will fail frequently to produce an equitable rate.

That the formula should produce an equitable rate, it would be necessary to determine the number of employee-days exposure in the container manufacturing department as compared with the regular department. As this is ordinarily impossible to determine, the next best thing would be to determine the actual payroll expended in the various departments. In this way only can the relative proportions of exposure be even approximated. If a determination of payroll is necessary, it is very evident that a payroll auditor at the end of the policy term is better able to determine the payroll expended in each department than an inspector at the beginning of the policy term. By giving to each process, which roughly represents each department, the proper manual rate, as proposed by Dr. Downey, applying such rate to the actual payroll expended in each department, as determined by the payroll auditor, as equitable a rate will be given the employer as would be produced by the formula method determined after a careful audit of the payrolls.

It is clear then that the formula method only complicates the matter. A further very great disadvantage is that it vitiates experience. At the present time on lamentably few classifications is experience available for the determination of rates. If a process classification were used, there being comparatively few processes and these few common to all industries, it would soon be possible to obtain sufficient experience to indicate proper rates. The formula method however, giving to each plant a different rate, or producing in effect an infinite number of classifications, will make it impossible ever to determine the proper rates for the different classifications.

The principal objection to process classification is the impossibility of determining the actual payrolls expended on the different processes. It has been pointed out that this objection is equally applicable to the formula method. I might also point out that this objection may be urged against the present system of classification. Let me illustrate by a manufacturing establishment with which I am more or less familiar. This plant manufactures carriages, chairs and automobile bodies. In accordance with the existing rate manuals there should be given to this plant a rate on the chair manufacturing, a rate on the carriage manufacturing and a rate on the automobile body manufacturing, and a division of payroll would be required accordingly. A process classification would classify this plant as follows: Foundry, machine shop, wood-working department and painting department. Each of these departments is distinct and in each department work is done on all the products turned out by the establishment. With a cost accounting system the payroll expended on each product can be determined of course; but it is the different departments that determine the hazards and not the partic-

ular article upon which the men happen to be working. I submit that a division of payroll in accordance with these departments would not only be more equitable but far more logical than the existing method of classification.

MR. MICHELbacher: In discussing Dr. Downey's paper, it should be understood that anything I say refers only to the practical side of the problem which is presented.

I have no doubt that Dr. Downey's suggestions, if they could be carried out in practice, would very much simplify the writing of workmen's compensation insurance. From a theoretical standpoint, it is probably desirable to have as few manual classifications as possible. With a few manual classifications, there will be a greater possibility of securing a sufficient payroll exposure for each classification. This will insure accurate premium rates as far as such rates can be determined by experience. It also follows theoretically that the underwriting of workmen's compensation insurance will be simpler with a few general, broad classifications to govern the underwriter in classifying risks. These two advantages are probably offset by the practical dangers which will creep into the business, first, by reason of a division of payroll in a given risk which must be made in order to enable the insurance carrier to properly assess the risk for insurance in accordance with rates based upon occupational or industrial classifications, and second, by reason of the dissatisfaction such risk classification would arouse among employers.

Mr. Downey very properly modifies his comparison between the German classification system and the classification system used by the Bureau in connection with its Basic Manual. He makes the general assertion that the "immense and varied industries of the German Empire are comprised by some thirty-five risk groups," and then modifies this assertion by stating that these thirty-five risk groups do not include territorial sub-divisions and that no mention has been made of the number of risk grades within risk groups.

As a matter of interest, I have consulted the 24th Annual Report of the U. S. Commissioner of Labor, Volume I, and find that the risk tariff of the accident association for the glass industry comprises six risk grades and twenty separate branches of industry. These should be compared with the number of classifications in the Basic Manual covering the glass industry, to secure a correct idea of the simplicity of the German system as compared with the Bureau system.

It is probably true that if the classifications in the Basic Manual were grouped according to rate, we should find that our Basic Manual does not contain more than six risk grades for the entire glass industry. When the work of the Conference Committee on Pure Premiums has been completed, the entire basic manual will contain but one hundred fifteen risk grades. At the present time there are not more than one hundred seventy-nine risk grades. It should also be noted that the branches of industry which are grouped

into six risk classes are more or less analogous to the manual classifications. For example, there is a classification "Manufacture of Plate and Window Glass"; another "Grinding of Mirror and of Plate Glass"; a third "Manufacture of Green Glass"; a fourth "Artificial Glass Flowers and Glass Fruits."

The tariff for premium rates used by the Accident Association for the Building Trades of the Northwest in Germany comprises fourteen risk grades and approximately twenty-seven separate industrial classifications. Again, the separate industrial classifications follow more or less what Dr. Downey has been pleased to term the "entrepreneurial" grouping method. There are, for example, individual classifications, for "Roofing," "Cabinet Making," "Tile Working," "Locksmithing," all of which goes to show that if the complete manual of rates for workmen's compensation insurance in Germany were compiled, it probably would be as lengthy as the manual used by the Workmen's Compensation Service Bureau.

As I understand the situation, the German employers started out with an idea similar to Dr. Downey's idea; namely, that all establishments should be grouped roughly according to general, broad divisions of industry. These groupings of industry have resulted in the formation of the various accident associations. There are accident associations for the glass industry, for the building trades, for the textile industry, etc. It was then found necessary to establish risk grades within these industrial groupings, in order that the cost of workmen's compensation insurance might be equitably distributed among the members of the association. In the beginning, this formation of risk grades was made on the basis of occupation or process in a number of these associations. Experience has shown (according to the report of the U. S. Commissioner of Labor) that computations of risk ratings by occupations or processes are too complicated for use and that several accident associations, which had adopted this method, have been compelled to give it up, because of the difficulties in carrying it out into practice.

What then is the lesson to be drawn from the German experience? It seems to me to be just this: The German employers starting out with a plan similar to Dr. Downey's plan, found it practically impossible to make that plan work out. The result was a modification of the rating plan to more nearly fit the industrial establishment—the "entrepreneurial" classification scheme had to be resorted to finally to make the mutual insurance scheme workable with the least amount of friction and dissatisfaction. We have found the same state of affairs in the United States in Washington, Nevada, Oregon and one or two other states where a general industrial grouping has been adopted for state insurance purposes in connection with workmen's compensation laws. The dissatisfaction which exists among certain employers in these states causes me to very much disagree with Dr. Downey's contention that the "common objection on the score of inequity is for the most part a misconception

tion." This then seems to me to be the greatest criticism, practically speaking, of Dr. Downey's plan. Under present conditions, such a plan would create great dissatisfaction among employers who would not be satisfied to have their industries divided into separate processes and grouped roughly with other industries of somewhat similar character for rate making purposes. We find today that with our present manual there is quite a rivalry among employers whose plants are thrown into a given classification for an adjusted rate which will more accurately base the insurance premium upon the characteristics of the individual risk.

Dr. Downey's plan, if put into practical application without any modifications whatsoever, would largely do away with the "Safety First" movement. If employers were to find their establishments divided by processes and grouped for insurance purposes with a resulting rate covering all of the risks in a given class, they would not be particularly interested in making their individual plant as safe as possible, for they would feel somehow that they were being assessed for accidents occurring in processes carried on in the worst possible manner and would consequently have no incentive to make their own plant as safe as it possibly could be made.

A modification which would probably obviate this danger would be the application of a schedule rating plan in connection with the occupational or industrial process risk grouping scheme. Instead of using a universal schedule rating plan, however, it would be necessary to have many individual plans to take care of the various characteristics of the processes or occupations comprising the separate risk groups. I agree that one universal schedule does not adequately meet the needs of the present rating scheme. The Workmen's Compensation Service Bureau recognizes this and has in preparation some seventeen individual schedules which will be used in connection with general classes of risks. Some day we shall probably have a schedule which is particularly adapted to risks engaged in woodworking, in glass making, in textile manufacturing, etc. The application of these schedules will, however, be confined to the establishment. Under Dr. Downey's scheme, the rate to be used in connection with such schedule would be what is at present termed "an average rate" obtained by dividing the payroll in a given establishment according to the character of the processes or occupations engaged in and using with these separate payrolls the proper rate.

I maintain that the average rating of an establishment can be done under existing conditions in just as satisfactory a manner as it can be done under Dr. Downey's scheme. To further this contention, I need only point to formulae which have been developed by the Workmen's Compensation Service Bureau, two of which are presented in a paper before the Society, entitled "Schedule Rating By Formula." Take, for example, the so-called "Container" formula. This formula, if applied to an establishment where con-

tainers are made, would produce an adequate rate based upon the degree of container hazard presented in the given risk. A division of payroll would not be necessary. Experience for the separate processes would not be necessary, for existing experience will give all the information necessary to put the formula into practical application.

Instead of rearranging the entire rating scheme, we can use the rating scheme we have at present with all of the experience which has been developed under this scheme, if formulae of this character are used wherever they seem to be necessary. The application of a formula of this character requires some statistical investigation, it is true. An investigation must be made to determine the average percentage of employees in a given establishment engaged in the various processes, but this investigation can be made with the existing machinery of the Inspection Department in a very short time. It will not be necessary to compile three or four years' experience to make the plan workable, and moreover, a formula of this character will accurately rate risks in accordance with the individual characteristics of these risks. Formulae will therefore do away with any dissatisfaction which may exist among employers. Each risk will be rated upon its individual merits, and after all, this is the only practical basis of rating at the present time, because of the diversified character of our industrial processes.

Buildings in which industrial establishments are housed differ widely; machinery used in creating a given product may differ widely; the character of the management and the moral hazard may vary widely from risk to risk; the physical condition of the plant may be entirely different as between two risks in the same town; widely different as between two risks situated in different states. All of these items must be taken into consideration. It is not fair to throw industrial establishments into groups and require the careful employer to pay for the losses of his careless competitors. Neither is it equitable to divide an establishment into processes and group processes for rate making purposes.

In closing, let me point out that Dr. Downey's plan would involve much additional work for statistical departments. The present classification system could not be entirely dropped for at least five years, because of outstanding claims. This would necessitate having two systems in operation for five years. The dropping of the present system would require a complete revision of each statistical office with detailed instruction in the new order of things for underwriters and statistical employes.

The work of the Statistical Committee of this Society in revising the Classification Code of the Bureau has made necessary the change of some two hundred thirty-five code numbers. Statisticians inform me that this change will cause a great deal of trouble in their departments. Imagine, if you can, what a state of affairs would be created if the entire manual were suddenly dropped and a new manual substituted for new business written after a certain date!

Moreover, I am not so certain that Dr. Downey's plan would be as simple as he wishes us to believe. Because the rate is the same for "Foundries-steel" and "Foundries-automobile mfg.," it does not necessarily follow that employers will be satisfied with these rates. Rate makers will always be called upon to justify rates. The only justification of rates is based upon experience, consequently, the statistician would be called upon, under Dr. Downey's plan, to keep separate experience, for each process in each industry. This will cause the statisticians' classification code to become as complicated, or even more complicated than the present code. This state of affairs is, of course, predicated upon the fact that employers will not change. If Dr. Downey's plan will do away with the necessity for justifying rates, then we may expect a simplification of statistical work. I do not believe, however, that Dr. Downey's plan will accomplish this end.

SCHEDULE RATING BY FORMULA.

BY

CHARLES S. FORBES.

It is the purpose of this paper to call attention to a method of rating compensation risks, which has already had some discussion and has been practically applied to several groups of classifications.

A more or less general discussion of this method took place at the joint Manual Committee meeting in the Hotel Manhattan, the latter part of September. It was pointed out that in certain classifications, there were inherent differences of degree of hazard within the same trade arising out of the organization of the particular risk; that these differences must be treated to avoid discrimination; that the making of further sub-classifications would lead to a very great increase in the size of the manual, and an undesirable subdivision of statistical data, and that a possible solution of the difficulty lay in an extension of the schedule rating plan along the lines indicated by the treatment of "Metal Goods, N.O.C."

A word of explanation regarding this method is not amiss at this point, as the subject is one which is not generally understood outside of the various committees that have been responsible for the innovation. Considerable complaint had been made by manufacturers over assignment to classification, "Metal Goods, N.O.C." The Manual rate was made high in order to furnish an adequate premium for certain risks involving a large stamping payroll. The application of the classification to risks of lesser hazard has produced some injustice, the tendency has been to avoid the use of the classification, and many risks have been forced into other classifications in order to escape the high rate. The committee found upon investigation that the essential difference between these risks lay in the percentage of stamping payroll as compared with the percentage of non-stamping payroll, the hazard increasing directly with the percentage of stamping payroll. In many of these plants, however, it is very difficult to keep a separation of stamping payroll, as employes work interchangeably on stamping presses and on other machines.

The inspection department of the Workmen's Compensation Bureau, after an extended investigation, proposed the following:

"First: Risks assigned to 'Metal Goods Mfrs.—N.O.C.' are subject to a special inspection for the purpose of determining:

- (a) Percentage of machine workers.
- (b) Number of hand fed stamping presses.
- (c) The total number of working machines.

Second: The following formula is applied as a method for determining the basic rate for such risks:

$$1.36 + 1.36 \left(13.3 \times M.W. \times \frac{S.P.}{W.M.} \right),$$

where

M.W. = machine workers.

S.P. = number of hand-fed stamping presses.

W.M. = total number of working machines.

The resulting rate will be the basic rate for the risk, subject to the usual modification, in accordance with the Universal Analytic Schedule and experience valuation.

The practical application of this formula has produced on the whole a very satisfactory result in the opinion both of the General Reference Committee of the Bureau and the Classification and Rating Committee of the Compensation Inspection Rating Board.

The general subject of "Container" hazard which was discussed at the Manhattan Hotel Conference has led Professor Whitney to work out the following method of treatment:

1. The average percentage of employes engaged in 'Container' work should be determined for each classification. Designate this percentage by the symbol 'A.'

2. The relationship between the "Container" rate and the governing rate should be determined for each classification. If, for example, the basic rate for a governing classification is .50 and the base rate for the "Container" classification is \$2.00, this relationship would be expressed by the multiplier 4. Designate this factor by the symbol "X." This factor can be determined from a consideration of the basic pure premiums. A statistical investigation need not be made.

3. On a given inspection, let the actual percentage of employes engaged in "Container" work to the total number of employes in the plant be "E."

4. Let " Y " equal the adjusted rate.
5. Let " R " equal the governing rate.
6. Let " R' " equal the container rate.
7. Let " R_0 " equal the theoretical rate which would apply if no Container work were carried on.

Professor Whitney assumes that the base rate for classifications of this character must be predicated upon a certain average condition which contemplates a certain degree of "Container" hazard, and obtains,

1. $(1 - A)R_0 + AR' = R$
2. $(1 - E)R_0 + ER' = Y$

The first formula is a special case of the second.

Formula 1 states that the average governing rate for a given classification of the character is made up as follows:

One portion is based upon the theoretical rate which should apply to the classification, if no "Container" work is carried on (R_0). This part of the rate is weighted by the average percentage of workers, not "Container" workers; the remaining portion of the rate is based upon the rate for "Container" manufacturing (R'). This portion is weighted by the average percentage of "Container" workers. In an average plant, the sum of the foregoing rates properly weighted is the governing rate for the classification. This formula is a special case of the general formula which we desire to use in properly distinguishing between risks presenting various degrees of "Container" hazard.

In the actual case (not average), E is substituted for A and the rate Y must be determined. To determine the rate Y , it is necessary to substitute for R_0 , the value obtained by solving Equation 1 for R_0 . This substitution gives the following formula:

$$\begin{aligned}
 Y &= \frac{(1 - E)(R - AR') + ER'(1 - A)}{1 - A} \\
 &= \frac{(1 - E)(1 - AX) + EX(1 - A)}{1 - A} R \\
 &= \frac{(1 - E) + (E - A)X}{1 - A} R \\
 &= R + \frac{(E - A)(X - 1)}{1 - A} R.
 \end{aligned}$$

The inspection departments have been asked to make a further investigation of the practical application of this formula, and the Rating Committees will gather as much experience as possible, in order to test its practicability. It is the general opinion of those who have made some examinations of the subject, that there are a large number of other classifications which, from a mathematical standpoint, present no difficulties under this method of treatment. The practical difficulties are: First, the derivation of a fair set of values for the elements of each formula by inspection of risks in the class; and, second, the evolution of a statistical method for testing these elements by experience. This latter proposition is a difficult one, and so far, has not been treated with any elaboration.

The fire companies, however, have recently found a statistical method for attacking a similar problem in their rating formulas, and our problem is one which will yield to a serious attack. A general application of the method by the inspection and rating board of a locality would, in the ultimate analysis, supersede the present rating by manual. In other words, the manual rate for a classification would bear a decreasingly important part in the final rate, and the elements of the schedule would largely determine the rate of the particular plant. This rate would be worked out by the inspection board, and filed with all companies for each risk, similar to the general method of rating adopted by the fire insurance companies.

We believe that this plan of rating has many possibilities as well as some difficulties, and the object of this paper is to bring the matter before the Society in order that a number of investigations along these lines may be started, and the whole subject receive the attention which the needs of the present manual will justify.

It is agreed by all that a further extension of the number of classifications is unwise, and some further method of rating must be devised in order to avoid obvious discriminations. The schedule method is one of the best solutions which has been offered up to the present time, and follows the experience of the fire insurance companies in their solution of the similar problem.

ORAL DISCUSSION

MR. SENIOR: The application of the metal-goods formula has resulted in developing individual rates, in what appears to be an equitable manner, for a great many risks which prior to the adop-

tion of the formula were given a class rate of \$5.67. In practice, of course, every company and every employer who succeeded through the application of the formula in reducing the rate in a given case from \$5.67 to a lower figure, was satisfied with the result. On the other hand, serious protests have come from companies and assured who were formerly rated under related classifications such as "brass goods mfg." or "copper and zinc goods mfg." or "sheet metal workers."

The main difficulties which we have encountered were due largely to the fact that with the adoption of the metal-goods formula, nothing has been done to eliminate present classifications which include metal stamping as part of the operations.

The reasons which have influenced the underwriters to rate metal goods on the basis of a mathematical formula developing an individual rate for each risk, were due to the fact that the rate for metal stamping is extremely high and that it is difficult to secure a reliable and accurate division of pay roll from employers for stamping operations. It was, therefore, primarily a practical necessity that induced the rating board committees to adopt that formula.

Whether it is possible to defend its adoption upon any scientific grounds is another question.

If it were possible to secure an accurate division of pay roll for stamping operations, it would be far preferable to write metal risks subject to a divided pay roll for stamping work. From the standpoint of the statistician, the experience results secured from the underwriting of a mixed classification like metal goods, n. o. c. are not satisfactory, for that experience does not bring out clearly the necessary data and basis for rate-making.

With reference to plants that manufacture containers for their product, the suggestion that an individual rate be developed for each plant upon the basis of a mathematical formula is open to several objections. It is quite true that the present method of rating such plants is not satisfactory and is perhaps illogical and inconsistent. For instance, for plants that manufacture containers for the use of their own products exclusively, a flat rate is applied, the container portion of the plant being rated under the governing classification. On the other hand, for plants that manufacture containers for their own product and also sell such containers to outside trade, a division of pay roll for the container portion of the risk is allowed. The investigation which we have made indicates that it is practical to divide the container pay roll in all plants. It would, therefore, seem to be doubtful as to whether it is advisable to rate such plants upon any other basis than upon a divided pay roll. The application of a given formula upon an inspection will not, obviously, develop an absolute and accurate rate. There must enter into such formula items relating to average number of employees or pay roll. Such items are necessarily speculative in character.

Furthermore, we meet with the serious statistical objection that the experience produced on risks of this character will not develop any correct basis for rate-making. It would, therefore, seem that where we are confronted with the type of risks conducting separate operations, which are subject to fairly accurate pay roll returns for each separate classification, the most equitable results may be obtained by creating separate rates for the separate classifications and not by the development of a flat rate for the entire risk.

MR. MOWBRAY: Mr. Forbes's paper presents some ingeniously worked formulae for differentiating between risks in the "Metal goods, n. o. c." classification according to the extent of stamping involved and for differentiating between risks similarly classified, in other cases according to the amount of container manufacturing done, without separating the pay roll in either case.

At first glance the formulæ seem to fill a real need but deeper analysis seems to show their use would not be an unmixed good, if good at all. The formulæ for the "Metal goods, n. o. c." classification bring out as the rate the result of a theoretical but not actual division of pay roll between "Sheet metal works" and "Metal stamping" but quote the rate under "Metal goods, n. o. c." under which classification presumably the experience would be reported. This experience would be of no value for rate-making and the rates for the classification will depend upon the experience with other types of risks, viz., "Sheet metal works" and "Stamping," in lines where pay roll division is followed. This to my mind is a serious objection. A similar but slightly different objection lies against the use of the second formula.

Having previously indicated my belief in the soundness of Dr. Downey's views on classification I cannot but look upon the introduction and use of such formulæ as a step in the opposite direction. To my mind it is much better policy to face the issue squarely, divide the pay roll where possible (I believe it can always be done for container work) and in other cases refuse to differentiate until the system of classification is so changed that differentiation naturally follows.

INSPECTION AND SCHEDULE RATING FOR COAL MINE INSURANCE.

BY

HERBERT M. WILSON.

When I was invited by your committee on program to address you on my subject I hesitated for some time to accept the invitation because I felt as a layman in appearing before you specialists concerning a matter which has occupied your professional talents for many years. I concluded, however, that regardless of my unfamiliarity with the subject and the fact that the methods to be pursued by The Associated Companies in schedule rating are not yet fully developed, I at least should gain sufficient benefit from your discussion of my paper to warrant me in running this risk.

You may recall that Mr. Carl M. Hansen in his address two years ago before the International Association of Casualty and Surety Underwriters stated that there were three methods through which merit rating can be successfully applied.

First, by assuming a hypothetically perfect plant, establishing the standards for safety therein and making charges for every deviation from these standards.

Second, by establishing a hypothetically very poor plant, applying the standards of safety established in the perfect plant, and crediting the owner for each item of standards complied with.

Third, by establishing an average plant with sub- and super-standards and corresponding charges or credits for each item of deviation therefrom.

The first he calls the most logical and scientific because it keeps before us at all times the standard of perfection aimed at, but there are some objections to it, especially on psychological grounds, because the base rate must be made comparatively low and be built up on by charging for deficiencies.

The second method calls for a comparatively high base rate which has a bad effect on securing business. In crediting reductions therefrom there is among others the objection that this method remunerates the employers for obeying the law.

The third method is that adopted by the Workmen's Compensation Service Bureau. This method has the distinct advantage that the base rate will be more easily determinable than under either of the other plans. It will more nearly approximate rates for insurance as based on the law of average.

The method which has been tentatively adopted by The Associated Companies is a fourth one not enumerated by Mr. Hansen. It is a combination of the first and third methods. It assumes the theoretically perfect mine, 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. No deviation or discretion is allowed the inspector from the charge values adopted. It then establishes as the basis rate for each state or coal-mining district that rate which would apply to the average mine, one predicted on the law of average over a wide area of the same type of coal formation, as derived from the large amount of statistical experience available from state mine inspection departments, and standardized by the U. S. Bureau of Mines.

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 adopted for the state or district give the adjusted schedule rate sought.

The relations which the Department of Inspection and Safety of The Associated Companies bear on behalf of coal-mining risks to the several member casualty insurance companies are quite similar to, though they differ in a few material respects from, the relations which the Inspection Department of the Workmen's Compensation Service Bureau bears on behalf of other industrial risks to the several subscribing casualty insurance companies. The chief point of difference is one which, however, while it affects the purposes of the two bureaus does not affect the methods employed in schedule rating by The Associated Companies. This chief difference consists in the fact that the associated companies act as one pooled or syndicated interest, each member receiving one-tenth of the net premium collected and each underwriting and being responsible for one-tenth of the liabilities; whereas, the larger group of casualty

companies served by the Workmen's Compensation Service Bureau acts each independently in receiving the whole premium earned on any risk and being each solely liable for the whole of any risk underwritten by it.

In some measure because of these differences, but particularly because the Department of Inspection and Safety of The Associated Companies had the way already blazed for it by the Workmen's Compensation Service Bureau, the former was confronted by a much easier task in the development of the methods of inspection and schedule rating necessary to coal-mine insurance under workmen's compensation. Furthermore, there was available to The Associated Companies as a scientific basis for its manual or base rate-making and for its inspection and merit rating a large amount of fairly accurate statistical data concerning accidents in coal mines, their causes and the possible means of preventing them which had been accumulated by the various state mine inspection departments and had been co-ordinated and utilized in the experimental work of the U. S. Bureau of Mines.

As a result of these conditions it seemed practicable at the outset to adopt what has been by some called the most scientific method of merit rating, viz., that based wholly on charges as distinguished from the system of charges and credits from a series of standards as adopted by the Workmen's Compensation Service Bureau. This decision was in a measure obligated, first by the opportunity to make use of the large amount of available statistical data showing fatalities by causes in each state, thus permitting the making of direct charges for improper mining practices or appliances in proportion to their effect on accident frequency, and, secondly, by the absence of standards as to safety in coal mining and the difficulty of fixing standards where the hazards are not those of machines, buildings or appliances but are chiefly such as differ with each mine according as the natural conditions under which the coal occurs and the methods of its extraction vary.

The reduction of the total number of charges made by the inspector against any mine to a system of credits and charges, thereby bringing into play the benefits of the merit system for schedule rating, is simply effected by the expedient of adopting in each state or mining district a standard percentage of perfection corresponding with the average mine. Any deviation in the number of charges recorded for the mine inspected, above or below the average

adopted as standard for the state, furnishes the basis for converting the charges into credits or charges and of consequently reducing or increasing the base rate adopted for the state.

There was available as a basis for the system the experience or statistical data tabulated by the Bureau of Mines from a study made of the causes of 49,733 fatalities officially recorded by state mining departments. These records extend over periods ranging from five to forty years according to the state. The Associated Companies has tested this data by the records of serious injuries, which are fairly extensive for some states, but less so in others, and though probably not accurate in any are doubtless reasonably consistent as to ratios of causes and because of the large number of cases available.

This accident experience by causes has been adopted by The Associated Companies as the basis of its system of inspection and merit rating.

It has been grouped for each state into ten classes of physical and two classes of moral causes of accidents. These are used as experience multiples according to percentages of each to the total.

The ratio of each of the ten classes of physical causes of accidents to the total fatalities studied was assumed to amount to sixty per cent. of all the preventive measures which might be adopted, the remaining forty per cent. of the preventive measures being allotted to the moral hazard or what the Workmen's Compensation Service Bureau classify under the heads of Safety and Welfare, and of General Order, Light and Sanitation, which groups are designated under the classification of The Associated Companies as Safety Organization and Safety Measures, respectively, to each of which is assigned one-half of the moral hazards.

Because the statistics of fatalities for the earlier years were not so reliable as the more recent data acquired since the creation in 1910 of the Bureau of Mines and because the data procured by the state departments for the Bureau of Mines since 1910 is of more scientific and co-ordinate nature, that only 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 of The Associated Companies for the whole United States as follows:

I. Safety Organization	20.0
II. Safety Measures	20.0
III. Surface Hazards	4.1
IV. Shaft Hazards	1.6
V. Haulage Underground	9.1
VI. Falls of Coal or Roof	28.3
VII. Explosives	3.2
VIII. Electricity	2.0
IX. Mine Gas	3.8
X. Coal Dust	5.0
XI. Mine Fires	0.6
XII. Miscellaneous Underground	2.3
Total	100.0

The above percentages or weights will differ in each state according to its experience. Thus, in Alabama the weight for coal dust (explosions) is 10.9, whereas in Iowa where coal dust explosions rarely occur the corresponding weight is but 2.1. Similarly, in Alabama the weight for falls of coal or roof is 28.0, and in Iowa 35.4.

Each of the above twelve experience classifications is subdivided into a number of secondary causes each of which if removed would make the mine more safe in so far as anything can be made physically safe with due allowance only for carelessness, negligence and unavoidable causes. This subdivision consists in dividing each class into 100 charge points or values and these are apportioned among the subdivisions of each class proportionally to their relative influences in producing accidents. Thus, for example under Class VII, Explosives, the 100 points are distributed among fourteen charge items, the presence of any of which may cause an accident in the handling or use of explosives. These are: the kind of explosive 10 points, surface magazines 4 points, maximum amount of explosive allowed per miner daily 8 points, method of carrying to face and storing underground 7 points, maximum amount and position of charge 12 points, use of mixed charges 4 points, methods of cleaning and loading holes 4 points, tamping material and method 5 points, shooting, by whom done 10 points, method of firing 10 points, time of shooting 5 points, treatment of misfires 12 points, careless use of powder and detonators 5 points, simultaneous firing of shots 4 points. Similarly, for the other classes.

It is pertinent to state here that while the adopted method of arranging experience weights for each class by states was obligated

by the existence of statistical data by states only, it furnishes by no means an accurate or scientific basis on which to schedule rate coal mines. This is because there are sometimes found even wider differences in the hazards of coal mining within the borders of one state than exist between two separate states. This is due to the differences in chemical composition and physical properties and occurrence of the coal. For example, this difference is so wide and so well known in Pennsylvania, as between the anthracite and bituminous districts, that fortunately the state mining laws and departments, as well as the statistics procured thereby permit the separation of Pennsylvania into two distinct districts with separate experience weights. Actually, for schedule rating purposes, there should be at least three districts produced by a separation of the bituminous coal mines into those which are gaseous and those which are non-gaseous. Similarly, for the state of Colorado, which like Pennsylvania, has a large catastrophe hazard, its mines should be divided and weights separately derived for at least three types or districts of coal in which the hazards of working differ materially. In Colorado, the chief catastrophe hazard is found in the gaseous or coking coals in the extreme southern portion of the state and another district of like kind which occurs near the central part of the state. In another portion of the state there occur lignitic coals with which the dust explosion hazard is probably very low, and in still another district non-gaseous bituminous coals are found. It is hoped through co-operation with the Bureau of Mines and also with the accumulation of experience by The Associated Companies to ultimately classify the coal mines by districts rather than by states. For the present this difference is cared for through the employment of inspectors skilled in the theory and science of mining as well as experienced in practical coal mining and inspection. Wherefore, a larger amount of personal latitude or deviation from the fixed charge values recorded in the inspection book is permitted these inspectors than would be desirable or necessary were the classification by mining districts or kinds of coal rather than by states.

Regarding the apportionment under each class of the 100 charge points among the several hazards as illustrated above for Explosives, it is recognized that these are subject to some modification with experience, though the experience so far had by The Associated Companies indicates much less liability to change in this

respect than in that relating to geographic classification. There was fortunately available a large amount of detail statistical data regarding the causes of mine accidents which aided materially in apportioning the charge points among the various subcauses under each class, and in addition The Associated Companies were fortunate in securing the advice of a number of mining men well qualified to discuss the subject. These included mining engineers, mine superintendents, state inspectors, the experts of the Bureau of Mines, and some of the more intelligent miners.

The inspector is provided with a Coal Mine Inspection and Rating Record somewhat similar in general arrangement to the Universal Inspection Report of the Workmen's Compensation Service Bureau. In this, under the twelve primary classifications are printed 148 principal sub-classifications each with the corresponding charge value adopted. In examining a mine he credits by check mark each item which he finds up to the standard provisionally adopted or enters the charge value in the appropriate column where the item of hazard falls below the standard. No latitude is allowed the inspector regarding the number of charge points he shall enter opposite the charge item. He may record the printed value only. Any recommendation for change therein is made by him as a comment.

After examination of the Inspection Report by the chief inspector there may develop reasons for modifying the charge values and the standards furnished the inspector authorize under certain circumstances the doubling of the charge value or its entire omission. Such remission of charge, for example, might be made under the classification Coal Dust even though the mine were dusty, were all sources of ignition removed, such as the firing of all explosives from the outside with all men out of the mine, coupled with the use of no open lights and of low voltage, well insulated and grounded electric installation. Under such circumstances the only source of ignition and the only opportunity for explosion would be present when there were no men in the mine to be injured. An occasion for double charge by the chief inspector would be, for example, flagrant lack of discipline or a particularly bad practice in shooting coal or the use of open or mixed lights in a gaseous or dusty mine.

The inspector transcribes the rough notes entered in his Record book to a carboned duplicate in letter form known as the Inspection

Report, one copy of which is retained in the Department of Inspection and Safety and one transmitted to the proposing company in order that the agent may take up in detail with the insured the nature of the hazards charged against this mine and may explain to him in detail or through reference back to the Department of Inspection and Safety have the mine operator technically advised as to the methods whereby he may correct the hazards charged and thereby earn on a subsequent inspection a reduction in his schedule rating.

The total charges entered by the Inspector under each class in his Report are transferred to a Rating Sheet which corresponds somewhat to the Universal Analytic Schedule of the Workmen's Compensation Service Bureau. The office and adjusted corrections made by the chief inspector are then entered. A correction may also be made for catastrophe hazard and under certain conditions for the proportion of payroll affected. The adjusted charge under each class is then multiplied by the experience weight for that class in the particular state. The effect is to make the charges under each class bear a direct relation to the accident frequency for that class in the state; as for example the frequency due to falls of coal, or to coal dust explosions in the particular state as distinguished from the accident frequency for the same class in another state.

The sum of these products of charges for the class multiplied by the class weight is a total percentage of charges for the state, or conversely this sum subtracted from one hundred gives the total relative percentage of perfection of the particular mine.

A number of methods of mathematically converting the total reduced charges or the percentage of perfection of the mine to a schedule rating have been tested. The essence of these lies in the adoption of a certain percentage of perfection as a standard or that corresponding with the average mine. This is also that which corresponds with the base or manual rate adopted for each state.

The only other element of the schedule rating plan of The Associated Companies yet awaiting final adoption is the fixing of standards for the several hazards. This has now been done tentatively and in a manner which will probably call for no more change hereafter than is now made from time to time in the safety standards adopted by the Workmen's Compensation Service Bureau. In the case of the latter the standards are as a rule those of a mechanical nature such as safeguards to machinery, protection to platforms or stairways, or other artificial physical hazards.

The standards for safety in coal mining are almost wholly of an entirely different nature, as they concern natural hazards of all kinds to which physical safeguards are difficult of application. They relate to the occurrence of gas in coals of different kinds and under different geologic and mining conditions. The occurrence of coal dust, its fineness and the condition of its admixture with air, its inflammability, the method of immunizing it by removal or wetting or admixture with non-explosive coal dust; the character and temperature of the source of ignition which may explode gas or dust, such as an explosive of more or less amount and of various kinds, the nature of the detonator which will fully explode the charge or may cause it to burn or blow out; the manner in which the explosive is placed which may effect its complete and harmless detonation or cause it to enflame or blow out; the resistance of the coal to the explosion which may affect either the possibility of igniting coal dust or the possibility of weakening the adjacent rock or roof thereby rendering it liable to disintegrate and fall at some subsequent date; the heat of other sources of ignition such as electric sparks, the flame of an open light, in fact a hundred interrelated elements none of which alone is practicable of standardization by the adoption of physical safeguards.

The moral hazards have been standardized to some extent by fixing the ratio of foremen, shot bosses and other safety bosses or inspectors to the number of employees underground and modified by the conditions and distances of travel underground; by defining the safety organization requisite, and the educational measures to be adopted for acquainting the miners with the hazards and the safe methods of their occupation; by the extent to which first aid materials and instruction, rescue apparatus, telephones, escapeways and other protective devices are necessary.

For the purpose of standardization mines have been divided into five classes, those employing less than ten men, those having between 10 to 50 men, from 50 to 150, from 150 to 500, and over 500 men, and the standards vary according to these classes.

Like the Workmen's Compensation Service Bureau the purposes of The Associated Companies in establishing a Department of Inspection and Safety may be stated, as follows:

To provide for the inspection of coal mines by mining men skilled in the inspection of mines with regard to the safety measures

applicable therein, and their classification according to merit as regards the safety and efficiency of methods, appliances and machinery, the care and discipline exercised in the management and conduct of the work, the history of the risk in respect to casualties, and such conditions, moral, physical or otherwise as may affect the safety of the mine operation.

To secure to mine operators equitable rates of insurance as a reward for efforts made to reduce the number of accidents and eliminate the danger of personal injuries to workmen.

ACCIDENT AND HEALTH INSURANCE FROM AN ACTUARIAL VIEWPOINT.

BY

WALTER I. KING.

Certain losses, the incident of which are unforeseen, do or may, sooner or later, fall to the lot of the individuals comprising any group of men. The chief function of insurance is to distribute these losses among all the members of the group so that no great strain will be borne by any individual. Of late insurance has further increased its usefulness in an attempt to reduce the losses sustained by the group, as evidenced by the accident prevention work of the casualty companies, the life extension work of the life companies and the fire prevention work of the fire companies. Yet the chief function of insurance still lies in the proper distribution of the losses among the various members of a group as they occur.

There are two fundamental principles to be observed in the distribution of these losses. It is quite necessary first, that in each case an actual financial loss be sustained. Second, that the losses incurred be distributed among homogeneous groups.

Insurance, then, is *completely* fulfilling the obligations of its existence when it compensates *for each and every loss sustained*, provided only a financial loss has been incurred and, further, those losses have been distributed among homogeneous groups.

In life insurance the death of an individual constitutes the loss for which compensation is paid, and the rate at which these losses occur is known as the "rate of mortality." Upon the discovery that this "rate of mortality" followed certain well-defined laws and hence for all practical purposes could be measured in advance, rests the development of actuarial science. Previous to this discovery the losses incurred were distributed yearly among the various members of the groups insured, but after the development of actuarial science it was possible to determine the *present* value of the *future* death claims that would occur in a given group and hence to distribute these losses in advance. So that today, while

life insurance represents a distribution of losses, it represents a present distribution of future losses through the accumulation of a sinking fund. It is possible, therefore, to provide for these losses by a definitely known uniform rate and thus make the burden on the individual as light as possible.

Through the advent, then, of actuarial science, life insurance is provided to the public today in the best possible manner with the least disturbance to the normal run of everyday affairs. This change in distribution of losses, however—i. e., the change of distributing future losses at the present time instead of distributing present losses at the present time—makes one more simple rule necessary, namely—it is necessary to be sure that “the insurance carried be commensurable with the loss likely to be incurred.” Whatever the form of insurance carried, then, all losses, provided they fall within these simple rules, should be compensated for and in such compensation we have the fundamental basis of insurance.

The benefits to life insurance from conducting the business along actuarial lines are many:

First, Indemnity is furnished for all losses incurred in the group.

This is possible because the tables upon which the distribution of losses is based are compiled by taking into consideration all losses incurred in the group. In this manner life insurance is completely fulfilling the obligation of its existence.

Second, It is possible to spread the fluctuation in losses over a period of years and thus make a level charge and reduce the burden of caring for these losses to a minimum.

Third, The benefits paid are standardized and hence are not subject to fluctuation through competition. I do not mean by this that life insurance is not subject to competition. Of course it is. But it is not subject to competition through increase in benefits offered, but rather through competition in business efficiency and underwriting ability.

Fourth, Elimination of public dissatisfaction because if insurance is once procured, then, subject to certain conditions to be fulfilled by the insured, the indemnity is paid when the loss occurs.

Such are some of the benefits derived from applying actuarial science to life insurance. Is it not, then, a feasible inquiry to ascertain if this science is not applicable to other forms of insurance? The purpose of this paper is to inquire whether or not

actuarial science can be applied to accident and health insurance and if so, if we cannot expect the above-named benefits to result therefrom.

At the present time, while accident and health insurance is a current distribution of current losses, yet the charge is figured one year in advance. Rather the premium charged is fixed or determined upon in advance and such policies written, and as much coverage granted, as the underwriter in his opinion deems the company can grant and still have a profitable proposition. The statistics of the home office are so kept as to enable the underwriter to determine what cases he can take and what cases he must leave alone.

Such a viewpoint is quite contrary to what constitutes the true function of insurance as measured by the three rules previously enumerated—namely:

First, Has an actual financial loss been sustained?

Second, Have the losses incurred been distributed among homogeneous groups?

Third, Is the insurance carried commensurable with the loss likely to be incurred?

Measured from these standpoints, accident and health insurance should furnish indemnity for all actual financial losses incurred through reason of accident or sickness, provided only the protection is procured in advance and there is nothing about the individual risk to make it unduly hazardous. But how far short the present viewpoint falls below this ideal standard can be shown by a little review of the business.

Under the present conditions accident and health insurance performs many functions, most of which are of public benefit.

First, It insures against loss of life from accidental means.

Second, It insures against loss of sight or limb from accidental means.

Third, It insures against loss of time through disability on account of accident or sickness.

Fourth, It provides many special benefits which are limited only by the fertile imagination of the underwriter.

The benefits granted under classifications Nos. 2 and 3 are not covered by any other form of insurance and in furnishing these benefits and thus recompensing society for actual financial loss in-

curred, accident and health insurance is today fulfilling in a manner the chief obligation of its existence.

There is considerable dissatisfaction, however, at the present time in the manner in which this function is performed. It has been easy for competition to drive companies to add one feature after another to their policies, particularly since they had no real knowledge as to the cost of their various features, until a point has been reached requiring a very free use of the cancellation privilege and limitation of liability privilege granted in the contracts. The result of this has been to restrict the legitimate field of accident and health insurance to offering special privileges to the so-to-speak super-standard cases, and in doing this accident and health insurance is failing to fulfill its legitimate field in insurance.

Previous attempts to adjust these troubles have failed chiefly because the companies have not recognized the fact that accident and health insurance must ultimately indemnify for all legitimate losses and that to do this, they must have a recognized standard table to measure these losses by. The statistical committee of the Association of Accident and Health Underwriters is working at the present time, preparing tables showing the cost of the special features in the contracts. This is a good thing, but in the writer's opinion does not go far enough. If they succeed in eliminating these special features, they will be no further advanced as far as fulfilling the true function of accident and health insurance is concerned than they were before competition made the companies add these special features to their policies. What the business really needs is a table by which the losses can be accurately measured and the future operations of the companies based thereon.

The theoretically true function of accident and health insurance today, as it seems to me, is to distribute at an annual level premium, or its equivalent, the future losses, which will occur during the working period of a man's life, arising from loss of sight or limb or hearing, and loss of time through disability resulting from accident or disease. This can be done only through the application of actuarial science to accident and health insurance and the question involved then is: "Is it possible to apply actuarial science to the problem at hand?"

Our ability to apply actuarial science to this problem depends solely upon our ability to deduct adequate tables from material possessed. We need tables giving:

Rate of disability from accidental causes,
 Rate of disability from disease,
 Rate of loss of sight,
 Rate of loss of hearing,
 Rate of loss of limb.

For convenience we will consider only the "Rate of Disability from Disease." By this we mean the number of days' sickness from disease to each year of exposure, it being necessary only that the disease be incurred during the year of exposure. The principles involved in discussing the formation of this table would be applicable to the formation of all the tables above indicated.

One would find two difficulties in trying to formulate such a table at the present time:

1. Most of the statistics kept by the companies in the past have been on the basis of premiums received and losses paid. This measure shows only whether the companies are conducting their business at a profit or not and in no way gives an accurate measure of the probable rate at which the losses will be incurred. It is not impossible, however, to obtain an adequate measure—i. e., the ratio of the days of sickness to years of exposure from the statistics in possession of the various companies.

2. All companies have made a free use of the cancellation clause, which fact probably has affected the statistics more than any one thing.

The results obtained, then, would be rate of disability from disease in cases subject to cancellation at option of the company.

With these exceptions, then, it would be quite possible to formulate adequate tables from the data at hand and with the companies conducting their business on such a table for some time, with the view of ultimately eliminating the cancellation privilege, it seems to the writer that it will be possible to bring the accident and health business in the end to the point where it will perform its full legitimate functions. For

First, subject only to the cancellation clause, there would be available a true measure of the future losses and the companies can begin to distribute future losses, as in life insurance, among present policyholders at a nominal level premium through sinking funds or reserves.

Second, with the policyholder acquiring an increasing interest

in his policy each year, through the accumulation of the sinking fund, there will be every reason for him to continue his contract in force from year to year, resulting in less lapsing and twisting of the business.

Third, with the contract a continuing one rather than a renewable term policy, it would be quite possible to reduce the acquisition expense and thus reduce the total expense to the insured.

Fourth, with a definite measure for the cost of each provision granted in the policies, all competition extending the coverage of policy contracts would be eliminated and a healthy competition based, as in life insurance, upon economy of management, underwriting ability and financial ability established.

In fact if the business was conducted along actuarial lines, based upon tables as above described, it would be quite possible to eliminate most of the present objections to the business and the manner in which it is fulfilling its obligations, with the possible exception of the cancellation clause, and furthermore it would furnish the only feasible basis for the ultimate elimination of this clause.

Since so many benefits are to be derived from treating accident and health insurance from an actuarial viewpoint, the question arises: "Why has it not been tried before?" I have not been able to answer this question to my own satisfaction.

We find from the early history of accident and health insurance that it was started without any knowledge of the proper rates necessary for the safe conduct of the business, and hence the underwriters had to feel their way along, giving a little more coverage for a definite premium as experience and competition dictated. This naturally led to the habit of viewing the business from the standpoint of measuring the dollars paid out against the premiums received, and as competition has become more and more keen, this experience as above indicated has been analyzed from the standpoint of policy forms, agencies and territory, and the results of a free use of the cancellation clause investigated. As one would naturally expect, each one of these elements has been shown to have its effect upon the total experience, and, therefore, underwriters have assumed that it would be impossible to construct a table from data subject to such a wide variation.

Few people acquainted with actuarial science, which requires a peculiar training itself, have worked compiling accident and health statistics.

And finally the effect of the variation in the experience has been given its greatest possible prominence in considering the accident and health contract as a one-year term contract. To illustrate the results of this, take an increase of 50 per cent. mortality in life insurance. Such an increase in mortality would increase the net premium at age twenty of a one-year term policy about 50 per cent., of an ordinary life policy about 30 per cent., and of a twenty-payment life policy about 25 per cent. In other words, the maximum effect in life insurance of such an increase in mortality is shown in the one year term contract and underwriters have always looked at the variation in disability in accident and health insurance from the standpoint of its effect upon a one-year term contract. If life insurance was written only on the one-year term plan and the underwriters realized that among apparently insurable risks occupation could cause a variation in mortality of 126 per cent., habitat of 78 per cent., physique of 180 per cent., personal history of 105 per cent. and family history of 194 per cent., one would not be surprised if that drew the conclusion that among such a heterogeneous conglomeration it would be impossible to deduce a mortality table which would in any way measure the future losses in life insurance. Yet such tables have been in use and have adequately performed their duties for many a year.

I am unable to find out from available data if the variations in accident and health experience, on account of cancellation clause, agents, territory and policy forms, are really as important as the many variations caused by similar reasons in life insurance. The variations in premiums charged by various companies for different classifications in accident insurance do not show an unmanageable variation. To illustrate:

Rate	Premium	Per Cent. Increase
Select and preferred	\$ 5.00	.00
Extra preferred	6.00	.20
Ordinary	8.50	.70
Medium	11.00	1.20

Probably the greatest proportion of business has been written under the first three classifications showing a variation of less than 75 per cent. Again it has been a rule-of-thumb principle of various companies that of health premiums 50 per cent. was required for loading and 50 per cent. for net premium to cover losses; in

accident insurance 50 per cent. for loading and 30 per cent. to 35 per cent. for weekly indemnity losses and 15 per cent. to 20 per cent. for death and dismemberment losses.

Considering this and looking at the figures of premiums received and losses paid, reported to the state of Connecticut during the last five years, we find as follows:

ACCIDENT EXPERIENCE.

Year	Premiums	Claims	Per cent.
1910	\$14,948,650	\$5,891,231	39.4
1911	15,530,935	6,622,466	42.6
1912	16,776,190	7,567,837	45.1
1913	17,260,084	8,204,198	47.5
1914	17,006,774	7,552,955	44.4
	81,522,633	35,838,687	44.0

HEALTH EXPERIENCE.

1910	3,963,198	1,626,203	41.0
1911	4,301,489	1,855,321	43.1
1912	4,645,067	2,011,460	43.3
1913	5,212,274	2,289,862	43.9
1914	5,374,230	2,426,248	45.1
	23,496,258	10,209,094	43.4

During five years, then, taking the underwriting methods of all companies reporting to the state of Connecticut, with all their various policy forms, habitat of insured, methods of treating cancellation clause, etc., there were produced results where the greatest variance in accident experience was 4.6 per cent. from the average and in health insurance 2.4 per cent. from the average. Even though these figures are based on premiums received and claims paid, where the possibility of fluctuation is the greatest, yet the small variation in percentage of claims is remarkable and clearly indicates to the writer's mind the feasibility of basing the operations of accident and health insurance upon accurately constructed tables and according to actuarial methods.

I know that this opinion will probably be challenged by the majority of the people in the accident and health business as theoretical and impractical. They all must admit, however, that the business today is suffering from a ruinous competition through the extension of coverage in the policy contracts; that there is public

dissatisfaction with the free use of the cancellation clause caused thereby and that there is a great demand for its elimination; and that there is bound to be a reaction against the use of the one-year term contract, where lapsing, twisting and large acquisition expense makes it possible for the company to return to the policyholder only 50 per cent. of the premiums paid in by him. They must not only recognize these facts but they must recognize a growing tendency on the part of legislatures to try to cure these evils through standard provisions, and unless something be done there is a great possibility that this agitation will develop standard benefits or even standard contracts.

If any way is possible—and I believe it is through the method outlined above—for the companies to effect a cure themselves, where the benefits will automatically be standardized, where it will be possible through the elimination of the one-year term contract to reduce the acquisition expense, and offer better inducements for the prevention of lapsing and twisting, and where the companies will have a safe foundation to establish a method which will ultimately eliminate the cancellation privilege granted to them at the present time, then I feel that such steps should be taken by the companies to bring these changes about before they bring upon themselves the restriction of legislative enactments.

ORAL DISCUSSION

MR. LAIRD: I agree with Mr. King in his statement that the logical form of accident and health insurance is a non-cancellable policy granting protection against disability during the working period of life. It seems to me, however, that a standard disability table based on the experience of American companies under the usual cancellable contract would be of little use in determining the premiums for benefits under a policy with no cancellation clause. A better guide would be found in some European experience, such as that of the Manchester Unity.

One company in Connecticut is already issuing a non-cancellable disability policy in connection with life insurance and a deferred life annuity. Unfortunately, however, when we calculate premiums on what are considered the most suitable tables now available, and make allowance for the different conditions under which the business will probably be conducted, we obtain rates which do not look particularly attractive to the man who does not recognize the value of the non-cancellable feature. With a few exceptions, the only prospects who appreciate the value of a non-cancellable policy are those who have had their accident or health insurance cancelled,

and as these persons are presumably impaired risks, they are not acceptable under the non-cancellable policy at the premiums charged for select risks.

According to the experience of the Manchester Unity, 1893 to 1897, with $3\frac{1}{2}$ per cent. interest, the terminal reserves under a policy granting indemnity of \$10 a month (payable during disability but terminating at a stipulated age—60, 65 or 70) are as follows:

1. PREMIUMS AND BENEFITS CEASING AT AGE 60.

End of Year	Age 20	Age 30	Age 40
5	\$ 6.45	\$ 8.89	\$ 9.79
10	13.64	17.29	16.96
15	21.10	23.91	16.67
20	27.83	27.31	0
25	32.51	22.47	
30	33.61	0	
35	26.00		
40	0		

2. PREMIUMS AND BENEFITS CEASING AT AGE 65.

5	\$ 8.88	\$12.61	\$15.87
10	18.99	25.48	30.46
15	29.95	37.84	39.81
20	40.95	48.37	36.25
25	51.18	52.99	0
30	59.24	43.72	
35	60.99	0	
40	48.25		
45	0		

3. PREMIUMS AND BENEFITS CEASING AT AGE 70.

5	\$11.15	\$16.28	\$21.89
10	24.09	33.86	44.51
15	38.56	51.97	64.79
20	54.11	70.28	77.39
25	69.95	85.77	68.38
30	85.70	92.89	0
35	98.32	77.32	
40	102.17	0	
45	82.67		
50	0		

MR. MOWBRAY: This paper is interesting and important because it approaches the topic of personal health and accident insurance from a new point of view. Heretofore we have been accustomed to look upon this branch of insurance, more than most others, from the standpoint of private enterprise. Mr. King invites us to consider its problems from the social-service point of view. In the light of the trend of public opinion, traceable through the Arm-

strong legislation, the fire insurance rate regulation movement, and more lately the compensation movement, toward this point of view when insurance in any of its branches is under consideration the paper is most timely. The future of the health and accident business as conducted by private companies seems to depend, in the final analysis, on the reconciliation of these two points of view. I do not believe they are entirely irreconcilable, and Mr. King points out what seems to be a way of approach.

Mr. King points to an increasing equity in the non-cancellable policy, as a safeguard against twisting. How far this will be so is not apparent on the face of things. It is well known to those who have studied the life insurance side of our profession, that the size of reserves depends on rate of *increase* in mortality, rather than merely the rate of mortality. Does the rate of morbidity increase with sufficient rapidity to produce substantial reserves?

While we cannot wholly ignore the apparent showing of the successive investigations into the experience of the Manchester Unity, that the extent of morbidity as a whole is increasing, there may be factors present affecting that experience which would not be present in personal accident and health insurance of the professional and middle classes. These factors are a growing tendency to make claims on the part of the insured and the stress and pressure of modern industrial life.

It may be that the failure to find an increasing rate of morbidity with age in the studies of American experience heretofore made, is due to the exercise of the cancellation clause or its equivalent the refusal to renew. If this is so it casts doubt upon the value of experience based upon one year term policies as the basis of rates and reserves for non-cancellable contracts. But Mr. King's proposals at least call for careful consideration from those in charge of this branch of the business.

MR. JAMES D. CRAIG: I agree with Mr. Mowbray in his statement that health policies issued for the working period of a man's life, assuming this to be up to age 60 or 65, would not produce such large reserves as are carried by life insurance policies under whole life contracts, unless some provision were included for an old age annuity commencing at the expiration of the health insurance.

I think the principal reason why actuaries have limited health policies to the one-year-term plan and included the cancellation clause is that they were afraid of an increasing rate of morbidity. While it is perfectly true, as Mr. King says, that no health tables have been prepared in this country, nevertheless standard tables have been prepared from the experience in England and each table has shown a higher rate of sickness than the previous tables, with the latest the Manchester Unity 1893-1897 showing the highest of all. The increases may have been due to the general increase in the sickness of the country at large or it might have been due to a larger proportion of lives insured in more hazardous occupations or

in less healthy conditions. The last Manchester Unity Table was the only one that attempted to go into the question of occupation by preparing four different rates to cover different industries. The increase may also be partly due to the insured's increased desire for participation in benefits, reflecting itself in recent years in application for sick pay on account of accidents or sickness, whereas in earlier times such incapacity would not have prompted any demand.

Whatever the cause, it is very probable that actuaries now realize more than ever before that the business of health insurance is more of a managerial proposition than an actuarial calculation and that when policies are issued on the one-year term plan with the cancellation clause, the power rests with the companies to change the basis of calculation whenever different conditions make a change desirable and prevent companies from being bound for long periods by contracts which become unprofitable when hazard increases beyond that upon which the premiums were predicated.

If long term contracts were to be issued without the cancellation clause, the actuary would not feel secure in his quotation unless he either provided an ample loading or else based his premiums upon select tables which in themselves provide for an increasing rate of sickness.

MR. FLYNN: Discussing the question as to whether the rate of sickness is decreasing or increasing from year to year, I would say that a study of the experience for the past ten years of The Travelers Insurance Company upon its personal health business shows no increase and, in fact, a very slight decrease. Examining the experience by three groups of ages, the younger ages (under 30 years of age), the middle ages (ages 30 to 50 inclusive) and the old ages (age 51 and over), we find no marked divergence from the slight decrease in the rate shown for all ages combined. This experience is based upon one year renewable term contracts which cover all diseases and which contain the privilege of cancellation or declination of renewal by the company. It is impossible for us to say to what extent the exercise of the last two privileges of the company has operated to modify the rate of sickness. Then again, the rate may have been affected largely by improvement in selection of business; that is, by selection from the more healthful localities, the more healthful age groups, and so on. The only conclusion which can be drawn is that, while the experience of American insurance companies writing health insurance upon the usual one-year renewable term plan may be of great value to the companies as a guide in the selection of business, it cannot throw much light upon the general question of the increase or decrease from year to year in the rate of sickness of the whole population—or of the preferred classes of the whole population.

RATING PERMANENT DISABILITIES IN COMBINATION.

BY

G. F. MICHELbacher.

The question of rating permanent disabilities in combination is one with which every Industrial Accident Commission will have to deal at some time.

There are a great many employees working today who have suffered a permanent disability involving the loss of an eye or an arm, or some other part of the body, who are likely to be injured again, the second injury resulting in permanent disability and causing a combination of injuries which must be rated.

The Industrial Accident Commission of the State of California has had occasion to discuss several cases of this character. In one instance, a worker who had previously lost the sight of one eye suffered total blindness as the result of a subsequent injury. This case was as severe as any but there were many other cases of similar character where the separate injuries were of less importance.

The question of adequately compensating employees for disabilities of this character is a very interesting one, and several plans have been suggested. During the recent session of the California Legislature a plan was proposed to the commissioners of the Industrial Accident Commission which would have removed all permanently disabled employees from the protection of the Workmen's Compensation, Insurance and Safety Act. This scheme would have required employees who suffer permanent injuries to furnish their own protection by purchasing insurance in the form of personal accident policies. The idea was to prevent a discrimination against crippled workers, for it is a foregone conclusion that if the Commission were to allow total permanent disability for the loss of a second eye, employers would not care to have one-eyed workers in their employment. The permanently disabled worker under this scheme would be called upon to pay his insurance premiums regularly to his insurance carrier for his personal protection, and the cost of his personal insurance would represent the price of an opportunity to seek employment without being discriminated against because of a more or less crippled condition. It goes without saying that this

plan was not proposed by an insurance man, for it is a well known fact that insurance carriers are not particularly anxious to secure substandard risks. This plan would have removed employees from the protection of the Act, and would have placed them in a position where they might possibly have been unable to secure protection at all, or if protection were secured it would have been necessary to purchase this protection at a cost in excess of the cost upon which the proposed scheme was based, that is, the cost of insurance for the standard man.

Another suggestion which has been followed in California is a good one practically, for its tendency is to overcome the discrimination which might exist should permanent disabilities of this character be rated in another manner. At present, the Industrial Accident Commission of the State of California rates permanent disabilities with reference to the immediate injury only, leaving out of consideration all injuries which might have existed previously. An eye is an eye, and each worker receives the same amount whether the loss of the eye causes total blindness or not.

The Commission was forced to assume this attitude because certain large employers threatened immediately to discharge all workers who were crippled in any way should another method of rating these disabilities be adopted.

The plan which we propose to discuss here is not of practical interest under existing conditions, because this question of meeting the discrimination against crippled workers is not taken into consideration. It is of interest only from a theoretical standpoint. This should be borne in mind in criticizing the plan suggested.

It is probably known to all readers that the California schedule for rating permanent disabilities makes use of the percentage system by rating permanent disabilities in accordance with the loss in earning capacity produced by the injury. Certain injuries which are conclusively presumed to create total permanent disability are enumerated; in all other cases the degree of permanent impairment is measured by comparing the injury to be rated with the injuries enumerated as causing 100 per cent. impairment, by taking into consideration not only the item of physical injury but also the items of occupation and age. The schedule of compensation itself, as set forth in the Act, makes full use to a certain degree of physical impairment of the rehabilitation theory. Theoretically, the rehabilitation theory is used for disabilities rated 60 per cent. and under.

The reason for using the rehabilitation theory up to 60 per cent. impairment has been very thoroughly explained by Professor A. W. Whitney in a paper presented before the Actuarial Society of America, Vol. XIV, Part II, No. 50. After carefully investigating the subject, it was determined that the worker himself requires 40 per cent. of his wage for his own support. When a worker is 60 per cent. impaired he can theoretically earn but 40 per cent. of his former wage, which in accordance with the result of this investigation is sufficient to provide for the upkeep of the worker alone, leaving no funds for the maintenance of the worker's family; consequently for a 60 per cent. permanent impairment the same amount of compensation is awarded as is awarded in the case of death with total dependency. Theoretically, the family of the worker who is 60 per cent. disabled is in just exactly the same circumstances as the family of the worker who is killed outright, for every cent the worker can earn following a 60 per cent. permanent impairment is used for the support of the worker and nothing is left to support his family.

Under 60 per cent. the rehabilitation theory used with reference to the Workmen's Compensation, Insurance and Safety Act, allows an injured person if permanently disabled, a period of 4 weeks from the date of injury for every 1 per cent. of physical impairment in which to regain his former efficiency as a wage earner. Thus, the worker is given 80 weeks for a 20 per cent. permanent disability, in which time he must regain his former status as a wage earner in the industrial community.

Now take the case of a worker who is say 80 per cent. disabled. This worker cannot theoretically earn the 40 per cent. of his former wage required for his own support. Unless he receives an adequate amount of compensation the cost of his upkeep will become a drain upon his family, to the extent of 20 per cent. of his former wage. The family in the case of a worker who is 80 per cent. permanently disabled is not in as good a position financially as the family of the worker who is killed outright. The worker, as far as the family is concerned, is worse than dead, because as before mentioned, the cost of his support becomes in part a drain upon the earnings of the members of his family.

In this case, and in all cases where injuries are sustained which are rated over 60 per cent., the family of the worker receives compensation equivalent to the compensation received in the case of

death with total dependency, and the worker is provided with a pension of a percentage sufficient when taken together with the percentage of his former earnings he is theoretically able to earn, to make up 40 per cent. of his former earnings. In the case of the worker who is 80 per cent. permanently disabled, this pension is 20 per cent.; in the case of a worker who is 100 per cent. permanently disabled this pension is 40 per cent. For practical reasons, no pension is paid until the amount of the pension is 10 per cent. Thus a worker does not receive a pension unless he suffers a 70 per cent. permanent impairment of his earning capacity. For these same practical reasons, the rehabilitation theory is accepted for disability up to and including 69½ per cent., and the same method of allowing 4 weeks rehabilitation time for each 1 per cent. of disability is followed. Thus the worker who is 69½ per cent. permanently disabled, receives compensation for 279 weeks. The rehabilitation theory is not, therefore, carried to its logical conclusion in the Workmen's Compensation, Insurance and Safety Act, because persons who are badly disabled are not considered as being able ever to regain their former earning capacity.

The dividing line has been placed at 60 per cent., and for all practical purposes at 70 per cent. Below 60 per cent. or 70 per cent., the rehabilitation theory is accepted.

If a man receive compensation for 120 weeks, for example, at the end of the 120 weeks his status as a worker should have been regained. For purposes of simplification, we shall assume that the rehabilitation process proceeds as a simple function of time allowed for its completion. In the case cited, at the termination of 60 weeks the person will be supposed to have regained 15 per cent. of his earning capacity, or to have assumed a status which we may term an 85 per cent. status. Under these conditions, the worker at the end of 60 weeks must be considered 15 per cent. inefficient, or 85 per cent. efficient.

In all cases, then, whenever the aggregate amount of compensation called for by a rating determined by consulting the schedule for the rating of permanent disabilities has been paid the injured person will be assumed to have regained all of his lost earning capacity. In some instances, the earning capacity, as far as one particular employer is concerned, is regained immediately, as for example in the case of the laborer who loses an eye and is immediately given employment as soon as he is able to return to work

by the employer in whose employment he was injured. In cases of this kind the compensation money is assumed to constitute a fund with which the employee will meet future contingent wage losses due to inability to find work to perform because of a loss in competing power.

When we speak of the status of a wage earner, we mean his power to get along in the industrial community as an industrial worker. If a crippled worker cannot secure employment we must provide a fund which, while allowing a proper share of the burden to fall upon the employee, maintains a certain standard of living. While a worker is actually disabled, he is allowed 65 per cent. of his average weekly earnings under the California Act. This places a burden of 35 per cent. of the employee's average weekly earnings upon the employee himself, and requires that he meet the contingency of disablement by industrial accident through some method of personal provision. In cases of permanent disability where the percentage of disability is low, the worker will probably be disabled principally through the effect of competition in his line of employment. Crippled workers find it difficult to find employment. It takes them longer to secure employment. Crippled workers are the first to suffer when periods of depression in the trade cause employees to be laid off. They are laid off for a greater period of time than workers who are sound, because of their crippled condition. While they work in a great many cases they are able to earn 100 per cent. of the wage they were earning when the permanent disability was sustained. When we speak of these workers having regained their status, we mean that they have been given enough compensation to form a fund to take care of these short periods of unemployment.

In discussing the problem of rating permanent disabilities in combination, it is taken for granted that the first injury in combination will never cause a disability which will require a rating in excess of 60 per cent. or 70 per cent. at the most. Thus we shall accept the rehabilitation theory in its complete form in discussing a method for compensating losses in combination of different members of the body when these losses occur at successive intervals.

If the period of time allowed for rehabilitation from the disability occasioned by the loss of one eye has been completed before the second eye is lost, the worker will be considered as having regained his status as a wage earner. If a percentage of this rehabilitation period has been completed the worker will be considered as having

regained a certain status which may be assigned a percentage. A status equivalent to the status at the time of the original accident we will term a 100 per cent. status. If a wage earner is allowed 200 weeks in which to rehabilitate his earning capacity he will have regained a 100 per cent. status at the end of 200 weeks, a 75 per cent. status at the end of 100 weeks, a 60 per cent. status at the end of 40 weeks, and his status immediately following the injury will be taken as 50 per cent.

It is the purpose of the method discussed here, always to rate the permanent injury in combination, as if the conditions existing following the last injury were the result of one accident, but to consider this rating with reference to the worker's status. Thus if a worker lose one eye in 1915 and the second eye in 1920, compensation for the 1920 accident will be computed on the basis of the loss of two eyes and the worker's status in 1920. In this case the period of time allowed for recovery from the disability occasioned by the loss of the first eye has been completed before the second eye is lost. Compensation for the loss of the second eye is therefore governed by the proper rating in the schedule for the rating of permanent disabilities by taking the following items as a basis for rating the combination disability:

1. Nature of physical injury or disfigurement: Loss of both eyes.
2. Occupation: The occupation of the injured person in 1920.
3. Age: The age of the injured person in 1920.

This rating will be used in connection with a status of 100 per cent., for the worker has theoretically regained a 100 per cent. status in the industrial community. To take a very simple case: If the rating for the loss of one eye is 30 per cent., the worker is allowed 120 weeks for rehabilitation. In the example under discussion the period elapsing before the second eye is lost is 5 years; the worker therefore has regained a 100 per cent. status before the second accident which renders him totally blind takes place. Using the proper items to consult the schedule for the rating of permanent disabilities we find the percentage of disability to be 100 per cent. One hundred per cent. of 100 per cent. gives 100 per cent. loss in earning capacity, and entitles the employee to receive compensation for total permanent disability.

If the second eye is lost during the period of rehabilitation, the

items used to consult the schedule for the rating of permanent disabilities will be exactly the same as given above, but the rating secured will be used in connection with the status not of 100 per cent., but of a percentage representing the adjusted degree of rehabilitation, considering the proportion existing between the actual period of rehabilitation consumed before the second injury to the total period of rehabilitation allowed for the original injury. Thus, to use the case cited above, if the second eye is lost within the rehabilitation period, say at the termination of 60 weeks, the rating found by consulting the schedule for the rating of permanent disabilities is 100 per cent., but the status of the worker at this time is only 85 per cent. and his loss in earning capacity is 100 per cent. of 85 per cent., or 85 per cent.

This theory may be further explained by the following examples of theoretical cases rated in accordance with the schedule for the rating of permanent disabilities issued by the Industrial Accident Commission of the State of California:

EXAMPLE I.

First Accident:

1. Nature of physical injury or disfigurement: Loss of one leg at or above knee joint.
2. Occupation: Laborer.
3. Age: 39.

The first accident causes a disability of 50 per cent. Compensation, therefore, should be paid for a period of 200 weeks.

CASE I.

Second Accident:

1. Nature of physical injury: Loss of remaining leg at or above knee joint.
2. Occupation: Laborer.
3. Age: 49.

To determine the rating which represents the degree of permanent disability in this case the schedule for the rating of permanent disabilities should be consulted with the following items in mind:

1. Loss of both legs at or above knee joint.
2. Laborer.
3. Age 49.

The schedule gives a rating in this case of 91 per cent.; the status of the worker is 100 per cent., because the period of rehabilitation allowed for the first injury has been completed, consequently the rating for the injury in combination is 91 per cent. of 100 per cent., or 91 per cent. Compensation following the second injury should be paid for a period of 240 weeks at the rate of 65 per cent. of the average weekly earnings, and for life following this period of 240 weeks at the rate of 31 per cent. of the average weekly earnings.

CASE II.

Second Accident:

1. Nature of physical injury: Loss of remaining leg at or above knee joint.
2. Occupation: Laborer.
3. Age: 41.

In this case the injured person sustains the subsequent injury, completing the combination, within the period of rehabilitation allowed for the disability occasioned by the first injury. As in Case I, the schedule for the rating of permanent disabilities is consulted with the following information:

1. Loss of both legs at or above knee joint.
2. Laborer.
3. Age 41.

The rating determined in this manner is $90\frac{1}{4}$ per cent.; the status of the injured employee at the time of the second accident is 75 per cent.; the percentage of disability is therefore $90\frac{1}{4}$ per cent. of 75 per cent. or $67\frac{3}{4}$ per cent. For this percentage of physical impairment compensation is payable in the amount of 65 per cent. of the average weekly earnings for a period of 271 weeks.

EXAMPLE II.

First Accident:

1. Nature of physical injury: Loss of major hand at wrist.
2. Occupation: Carpenter.
3. Age: 41.

Rating, 52 per cent.

Period of rehabilitation: 208 weeks.

CASE I.

Second Accident:

1. Nature of physical injury: Loss of minor arm at elbow.
2. Occupation: Laborer.
3. Age: 50.

Rating, 100 per cent.

Status, 100 per cent.

Degree of physical impairment, 100 per cent.

CASE II.

Second Accident:

1. Nature of physical injury: Loss of minor arm at elbow.
2. Occupation: Carpenter's helper.
3. Age: 44.

Rating, 100 per cent.

Status, 87 per cent.

Degree of physical impairment, 87 per cent.

NOTE ON THE APPLICATION OF RECENT MATHEMATICAL-
STATISTICAL METHODS TO COAL MINE ACCIDENTS,
WITH SPECIAL REFERENCE TO CATASTROPHES
IN COAL MINES IN THE UNITED STATES.

BY

ARNE FISHER.

I shall in the present little note make an attempt to show how some recent researches on mathematical statistics as carried on during the last five to ten years, especially through the investigations of the English biometricians and several Scandinavian statisticians, may be used in computing the various frequency ratios in connection with coal mine accidents and be used as the basis for possible future rates of assurance of various risks coming under this category.

As nearly all scientifically computed assurance premiums are based upon the theory of probabilities one must first investigate whether the accidents in the coal mining industry follow the laws of mathematical probabilities or may be made to conform to such laws. The old belief, originally due to the otherwise great German mathematician, Gauss, and still maintained by many statisticians of our present time, that certain statistical frequency ratios are identical to mathematical probabilities defined in the usual way as the ratio of the equally favorable cases to the coördinated possible cases, was long ago exploded as being fallacious. All statistical series are subject to perturbations of various sort of a quite different nature than the fluctuations in the ordinary games of chance, which follow the laws of mathematical probabilities. It is one of the paramount duties of the statisticians to try to measure the magnitude or force of such external disturbing influences in a purely quantitative manner. Is it possible to measure such perturbing influences? This question must be answered in the affirmative. We possess fortunately a powerful and easily applied criterion in the Charlier coefficient of disturbancy, denoted by the symbol 100ρ .

In the discussion of the instructive and valuable paper by Mr. Hansen at the last meeting of the society I mentioned this coefficient of disturbancy and gave its numerical value as to coal mine

accidents in various countries in the period 1901-1910. My computations were at that time not finished and I am able now to give some more detailed information in regard to United States. I give below a detailed computation for the Charlier coefficient of disturbancy in regard to fatal coal mine accidents in the period 1900-1914 as reduced to a stationary sample population of 630,000.

NUMBER OF PERSONS (m) KILLED IN COAL MINES IN UNITED STATES.

$$s = 630,000, N = 15, M = 2,291.$$

Year	m	$(m-M)^2$
1900	2,173	13,924
01	2,048	59,049
02	2,337	2,116
03	2,016	75,625
04	2,205	7,396
1905	2,286	25
06	2,111	32,400
07	3,074	613,089
08	2,293	4
09	2,520	52,441
1910	2,470	32,041
11	2,350	3,481
12	2,060	53,361
13	2,350	3,481
1914	2,070	48,841
Sum....	34,363	997,274

Hence we have:

$$M = 2291, \quad \sigma^2 = 66485, \quad \sigma_B^2 = 2289.7$$

and

$$100\rho = \frac{\sqrt{\sigma^2 - \sigma_B^2}}{229.1} = 11.06.$$

This large value of the Charlier coefficient of disturbancy clearly indicates the presence of perturbative influences. Looking over the records we notice a large number of mine disasters, chiefly due to explosions and fires, in which a large number of workingmen lost their lives. Such catastrophes can not be said to come under the category of ordinary mine accidents, which are a common every day occurrence. If we now eliminate such accidents in which five or more persons lost their lives from the original data the new series ought to give us a truer picture of the more common

or ordinary fatalities. The catastrophes are then to be treated separately.

The following table exhibits the number of fatalities in the same period after this elimination has been performed.

NUMBER OF PERSONS KILLED IN COAL MINES IN U. S. AFTER ELIMINATING
CATASTROPHES RESULTING IN THE LOSS OF 5 OR MORE LIVES.
(1900-1914.)

$$s = 630,000, N = 15, M_0 = 1,950.$$

m_k	$m_k - M_0$	$(m_k - M_0)^2$
1843	- 107	11,449
1863	- 87	7,569
1837	- 113	12,769
1768	- 182	33,124
1911	- 39	1,521
1964	+ 14	196
2075	+ 125	15,625
2190	+ 240	57,600
1967	+ 17	289
2053	+ 103	10,609
2085	+ 135	18,225
1984	+ 34	1,156
1839	- 111	12,321
1957	+ 7	49
1810	- 140	19,600
$\Sigma =$	- 779 + 675	202,102

Hence we have:

$$b = (675 - 779):15 = -6.93, \quad M = M_0 + b = 1943.07,$$

$$\sigma^2 = 13429, \quad \sigma_B^2 = 1943, \quad 100\rho = 5.512.$$

Although the coefficient of disturbancy has been reduced about 50 per cent. the perturbing influences are still very marked. In the period from 1900-1909 these perturbations may partly be explained by what I have termed "secular" or "evolutionistic" influences, showing an increase of deaths from year to year in this particular period. These secular changes may easily be determined by computing the secular coefficient, β . Another source of disturbing influences is the variation of actual working days in the coal mines. No doubt strikes and other disturbing influences have in some years reduced the number of working days below the normal 250 days, which seem to be the average number of days of actual labor of the American coal miner. So far I have not been able to

find reliable data collected in compact form necessary for a mathematical analysis along such lines. Once having these data it would be a very simple matter to compute a secular coefficient and determine the possible presence of secular disturbances.

The above computations of various statistical characteristics relate to periodic disturbances for the whole union. It is, however, equally important to determine disturbances as to locality. Conditions in coal mines are by no means uniform in all the states and the accidents will be influenced accordingly. I have therefore arranged the fatal accidents in twenty states for the year 1914 and computed the various characteristics. As the number of persons engaged in coal mining varies greatly from state to state it is not possible to apply the methods of simple reduced series as was done above. The series must be weighted. For the theory of weighted series I refer to my book on "Probabilities" and shall restrict myself to give the following scheme for the actual computations of the characteristics.

REDUCED AND WEIGHTED SERIES OF FATAL COAL MINE ACCIDENTS IN 20 STATES DURING 1914.

s_k = Miners Employed, m_k = Number of Deaths, $s = 1,000$, $N = 20$.

	s_k	m_k	ps_k$	|m_k - ps_k|$
1. Alabama.....	24,552	128	73	55
2. Colorado.....	10,550	75	31	44
3. Illinois.....	79,529	141	237	96
4. Indiana.....	22,110	44	66	22
5. Iowa.....	15,757	37	44	7
6. Kansas.....	12,500	33	37	4
7. Kentucky.....	26,332	61	79	18
8. Maryland.....	5,675	18	17	1
9. Missouri.....	10,418	19	31	12
10. New Mexico.....	4,021	18	12	6
11. Ohio.....	45,815	62	136	74
12. Oklahoma.....	8,948	31	27	4
13. Pennsylvania (Anthr.).....	175,745	595	524	71
14. Pennsylvania (Bit.).....	172,196	402	513	111
15. Tennessee.....	9,580	26	29	3
16. Texas.....	4,900	11	15	4
17. Virginia.....	9,162	27	27	0
18. Washington.....	5,730	17	17	0
19. West Virginia.....	74,786	371	223	148
20. Wyoming.....	8,353	51	25	26
Σ:	726,659	2,167		706

From the above data we obtain:

$$p_0 = \frac{\Sigma m_k}{\Sigma s_k} = 0.002982, \quad f_2 = \sqrt{\frac{20 \times 1000}{726659}},$$

$$\vartheta = f_2^2 \times 706.20 = 0.9716, \quad \sigma = \sqrt{\frac{\pi}{2}} \cdot \vartheta = 1.2177,$$

$$100\rho = 100 \frac{\sqrt{1.4828 - .0817}}{2.98} = 39.70.$$

The exceedingly high value of the coefficient of disturbancy indicates beyond doubt great variations from state to state. It seems therefore out of the question to employ frequency ratios based upon the experience of the Union as a whole as such average ratios would not represent the actual ratios in each individual state. Computing the coefficient of disturbancy for various states after the elimination of the catastrophes I find the value of ρ to vary greatly. States like Washington and West Virginia exhibit large disturbances whereas the Charlier coefficient for such states as Michigan and Iowa is imaginary, showing very small fluctuations in the frequency rates from year to year. In other words the number of fatal accidents cluster in those states closely around the mean. Owing to the lack of time I am not able to give a complete result of my computations for the various states producing coal in large quantities. The above examples illustrate, however, fully how such a research may be carried on.

In the absence of a complete analysis of fatal coal mine accidents as to states I shall now turn to the second—and in some respects the most important part of this note,—namely the determination of the probabilities of a catastrophe during a certain period, say a full calendar year. As stated before all accidents resulting in the loss of five or more lives are in this note considered as catastrophes. While in the previous investigations the single person was the unit in the statistical series, we must here take a certain group of individual persons as the unit. This naturally leads to a classification as to the severity or intensity of the various catastrophes. A disaster resulting in the loss of say 8 lives can in no way be compared with a disaster with a loss of 200 lives. Thus we are forced to divide the catastrophes in various classes of magnitude. Such a division is by no means uncommon in heterograde statistics. We meet it for instance in stellar statistics dealing with the brightness of various stars.

In accident statistics of this kind it is of course impossible to give hard and fixed rules as to the choice of classification of the severity of catastrophes. I have for my own purpose divided the various catastrophes as reported by the Bureau of Mines in the following classes:

Catastrophes of 1st magnitude resulting in the loss of	5-9	lives.
“ “ 2d “ “ “ “ “ “	10-19	“
“ “ 3d “ “ “ “ “ “	20-49	“
“ “ 4th “ “ “ “ “ “	50-99	“
“ “ 5th “ “ “ “ “ “	100 or more	lives.

This somewhat arbitrary choice of magnitudes may perhaps be improved for practical purposes. Such a change in classification does not, however, alter the method of the computation of the various statistical characteristics to which I now shall turn my attention.

Catastrophes of this kind come under the domain of heterograde statistics and are most successfully treated by means of the frequency curves of the Charlier B type. This type of frequency curve, which also may be called “the curve of rare events,” relates to such events whose absolute frequency as compared with the total population under observation may be considered small.

The values of the probabilities of the occurrence of such rare events are given by the following equation of a Charlier B curve:

$$F(x) = B_0\Psi(x) + B_1\Delta\Psi(x) + B_2\Delta^2\Psi(x) + \dots$$

where

$$\psi(x) = \frac{e^{-\lambda} \sin x\pi}{\pi} \left\{ \frac{1}{x} - \frac{\lambda}{1!(x-1)} + \frac{\lambda^2}{2!(x-2)} - \frac{\lambda^3}{3!(x-3)} + \dots \right\}.$$

The function $\Psi(x)$ vanishes for all integral negative values of x . If it vanishes for other values of x is of no consequence as far as the theory of probabilities is concerned.

For positive integral values of x —the only values in which we are interested in this connection—the generating function $\Psi(x)$ simply becomes:

$$\psi(r) = \frac{e^{-\lambda}\lambda^r}{r!} \quad (r = 1, 2, 3 \dots),$$

which is the Poisson exponential or the expression of the Law of

Small Numbers, so termed by the Russian statistician, Bortkewitsch.

The frequency curve now takes on the following form:

$$F(x) = \psi(x_\lambda) + \gamma_2 \Delta^2(x_\lambda) + \gamma_3 \Delta^3(x_\lambda) + \dots$$

This is the final formula to which I have fitted the various curves. I shall for obvious reasons not give the computation of all the various classes of magnitudes but limit myself to the class of the first magnitude. This class by the way exhibits the poorest fit and will for this reason serve as a safe test for the use of the method in practice.

In order to determine the paramaters λ and γ_2 I arranged the catastrophes for a period of 25 years in the following table.

x	$F(x)$	x	$F(x)$
0	1	8	1
1	1	9	0
2	3	10	1
3	4	11	1
4	5	12	1
5	2	13	0
6	2	over 14	0
7	3		

This table must be interpreted as follows:

1 year exhibited	no catastrophes	of 1st magnitude.
1 " " "	1 " "	" " "
3 " " "	2 " "	" " "
4 " " "	3 " "	" " "
	etc.	

I shall not give a detailed computation of the two paramaters λ and γ_2 but shall refer interested readers to my forthcoming second volume of "The Mathematical Theory of Probabilities and its Application to Frequency Curves and Statistical Methods." (Macmillan Company, New York.)

The actual computation yielded the following results:

$$\lambda = 4.92, \gamma_2 = 2.954.$$

Hence we have:

$$P_x = \psi(x_{4.92}) + 2.954 \Delta^2 \psi(x_{4.92}) + \dots$$

where P_x is the symbol for the yearly probability of the occurrence of number (x) of catastrophes resulting in the loss of 5-9 lives. The value of the Poisson exponential for various values of λ is given in various tables of which one will be found in the above mentioned treatise.

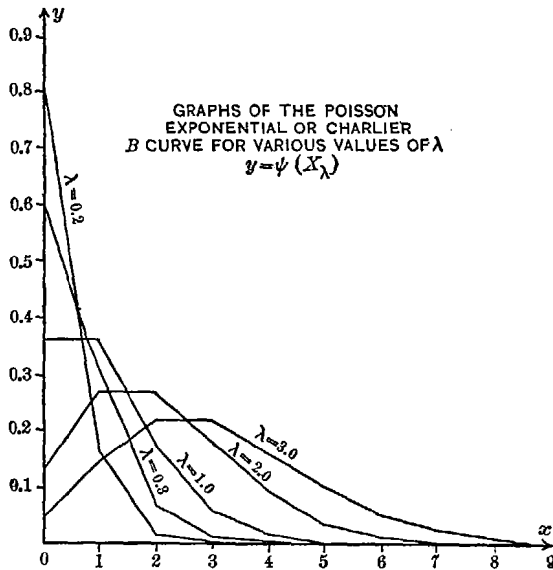
The whole computation of the parameters and the value of P_x may be performed in less than twenty minutes by means of an arithmometer and yield the following final values:

x	P_x	$25P_x$	Observed Frequency
0	.021476	.5	1
1	.077307	1.9	1
2	.134602	3.4	3
3	.152783	3.8	4
4	.132903	3.3	5
5	.104802	2.6	2
6	.087780	2.2	2
7	.079806	2.0	3
8	.069656	1.6	1
9	.055021	1.4	0
10	.038128	1.0	1
11	.023226	0.6	1
12	.012557	0.3	1
13	.006094	0.2	0
14	.002682	0.1	0
15	.001074		
16	.000403		
17	.000135		
18	.000044		
19	.000016		
20	.000003		
$\Sigma =$	.999999	24.9	25

In order to make a comparison between the curve values and the actual observed data it is necessary to multiply the annual probabilities P_x with 25, which was the period from which the data were selected. The curve values and the observed values are shown alongside each other in the above table. Altogether I think the fit is quite satisfactory and I doubt whether it can be much improved by using other methods. Possibly a better fit could have been obtained by computing the additional parameter γ_s in the infinite frequency series.

The present brief outline constitutes by no means a complete

analysis of the problem of coal mine fatalities. My chief object in presenting the results was to call the attention of the members of the Society to the practical use of the modern researches on mathematical statistics. Casualty actuaries and statisticians deal much more with heterograde statistical series than their colleagues in the life branch, who treat homograde series almost exclusively in their work. The theory of the heterograde series is much more difficult than that of the homograde series. The actual application of the theory in practical computations is quite simple, however.



The above graphs give an idea of the form of the Poisson exponential or the first term in the expression for the Charlier B curve for various values of the parameter λ . It will be noted that the curve is decidedly skew. Skew curves are a fixed and hard rule in vital statistics rather than an exception. In statistical research in various fields in biology and economics I have found the Gaussian Normal Curve of Error to be a very rare occurrence. For this very reason, I fear, I cannot agree with the fundamental hypotheses as given by Mr. Mowbray in his paper in "*Proceedings*," I, 24-30.

BURGLARY INSURANCE STATISTICS.

BY

FRED S. GARRISON.

Burglary Insurance in various forms has been written in the United States for approximately twenty years. During the year 1894 there was only one burglary insurance company operating in this country, and that company insured banks only. The volume of premiums for that year amounted to \$48,360 and the losses to \$5,930. Prior to 1894 a few local burglary insurance companies had started writing this line of insurance in one form or another, but they were either short-lived or glad to drop the new venture and take up other lines which were more profitable. A year or two later other companies entered the field; one of them devoting most of its efforts to insuring residences and the other to insuring stores and mercantile establishments. Several other companies entered the field during the next few years and began writing all lines of the burglary insurance business, insuring residences, stores and mercantile establishments, office safes, bank safes and vaults, and messengers and paymasters against loss by robbery or hold-up. During the year 1914 the total net burglary insurance premiums written by all companies in the United States amounted to \$4,225,594 and the losses paid aggregated \$1,625,697.

The rates at which the business has been written were never based on actuarial data, because until recently, only a very few of the companies have kept the business segregated so as to show the experience under the various forms of policies issued. This condition has made it difficult to conduct the business properly, but practically all of the companies now realize the necessity of basing rates for the various coverages on actual statistics.

The companies formed an Association called the Burglary Insurance Underwriters Association, which has been in existence about ten years. It was reorganized in March, 1912. Early in 1911 the Association established a statistical bureau for the purpose of combining the experience of all the companies so that rates could be based on the actual exposure under each of the various forms of

burglary, theft and robbery insurance. Nineteen companies were members of the Association at that time and each agreed to furnish the bureau monthly, or at regular intervals, with the necessary information set forth on large sheets that were provided for the purpose. These sheets called for the various classifications of residence business only, no attempt having been made at that time to collect the experience on the other burglary lines, such as mercantile open stock, mercantile safe, messenger and paymaster robbery and bank burglary. The companies were not requested to furnish the amount of premiums written, but merely the number of policies issued, segregated according to the amounts of insurance, because the rates for residence business are based on a graduated scale. The object was to determine the number of policies exposed to loss under each amount of insurance, expressed in even thousands and to reduce the number so issued to an annual basis. The columns on the sheets were arranged so as to show the total amount of insurance under the various denominations of residence policies issued, beginning with \$1,000 and there was also one classification for all policies of less than \$1,000. The sheets were also arranged so that the figures could be shown by years of business.

The net number of policies exposed for one year divided into the paid and outstanding losses thereunder, gave the loss cost per policy per year. The loss cost so obtained, multiplied by the factor $2\frac{1}{2}$ indicated the proper rate to be charged, assuming that 40 per cent. should be the maximum loss ratio to premiums.

In addition to showing the loss cost per policy per year valuable information was obtained as to the size of residence policy under which the largest number of losses occurred and the total amount of losses, under each policy classified by sizes. It was found that the largest number of losses occurred under policies issued for \$1,000, as would naturally be expected, because a large majority of residence policies are issued for that amount. The information as furnished on these sheets was also divided so as to show the experience on detached houses, elevator apartments, flats, hotels, stables and garages separately and was still further divided to show the experience under each classification and denomination of residence policy, arranged by states and also by the larger cities.

The experience was furnished the bureau in this manner for three years, but some companies found it difficult to report the correct

figures on canceled policies that were not canceled from date of issue. The system required that an annual policy canceled at the end of six months be treated as one-half a policy in force for one year; but it was found that some companies were reporting such canceled policies as a whole policy canceled, instead of a half policy canceled. It was considered unwise to have the premiums reported because of the possibility of a rate war, which would make the experience based on premiums valueless for rate making purposes. Another reason was that changes in rates were occasionally made and it would have been impossible to have determined what rates had been charged on the business reported in bulk to the bureau.

The total amount of insurance under all policies exposed for one year, grouped together regardless of the size of policy, and divided into the loss would have furnished the pure premium per thousand dollars of insurance per year; but such a result would have been of no value for rate making purposes under the present conditions, because such a total could not be divided into the various denominations of policies issued. In other words, under the present system of rating it is necessary to determine the pure premium under thousand dollar policies separately, two thousand dollar policies separately, and so on.

The system used would have furnished accurate results if all the companies had furnished accurate figures; but an investigation of the methods used by the various companies indicated that the information furnished by some of them was not reliable. The Association therefore decided that a new method should be devised and a committee was appointed early in 1914 for this purpose. The committee worked on the problem for nearly a year, the greatest difficulty encountered being that of devising a system which would not only furnish accurate results, but which would be satisfactory to all companies. Those companies which wrote both liability and burglary insurance could furnish the figures through their actuarial departments; but several companies wrote burglary and no liability insurance. A system was finally recommended by the committee and adopted by the Association which can be used by all companies and which will furnish accurate results.

The new system requires each company to send the Bureau either a punched or written card for each policy issued and canceled. This card is called an "exposure card." Provision is also made

for the companies having actuarial departments to report their experience in tabulated form if they so desire. The committee believed that the companies having no actuarial departments would be much more likely to correctly fill in the items on the individual cards, than they would be to furnish the data in complete tabulated form. The original plan called for two "exposure cards," one for policies issued and the other for policies canceled. The two cards have now been combined in one. The items of information on this card are as follows: Company number, year of business, month and year charged, form of policy, endorsements, policy or other identifying number, amount of insurance, class of risk, territory, state, city, premium written, term in months, premium canceled or unearned premium, and unexpired number of months. A card is provided for losses. This card shows the same data as the "exposure card" except the written and canceled premiums, the policy term and policy number. The extra items are the claim number, amount of loss, cause of loss, condition of premises (whether occupied or vacant), kind of property lost, ownership, and month and year loss occurred. The three year business will be kept separate from the one year business so that the experience may be obtained on an earned basis. The loss cost per policy per year under this system may be obtained by dividing the losses by the total number of months of exposure under each class of risk and denomination of policy and by multiplying the resulting quotient by twelve.

The quotient obtained by dividing the total number of months of exposure into the amount of loss on each class of property and multiplying the quotient by twelve, will furnish the loss cost per policy per year, on each of the various kinds of property, so that the rate can be determined on jewelry, silverware, clothing, money, and miscellaneous articles separately.

The losses are further segregated as to cause so that it will be possible to determine whether burglars who actually break into houses steal more jewelry, silverware, clothing and similar property than domestic servants or sneak thieves. It will also be possible to determine the number and amount of losses occurring in vacant houses as distinguished from those which are occupied; and the data will again be segregated as to the kind of property stolen, and so forth. The same is true of losses occurring during fire and while mechanics or workmen are on the premises. The information will

BURGLARY INSURANCE STATISTICS.

BURGLARY INSURANCE UNDERWRITERS ASSOCIATION
 Exposure (White), Cancelled (Cherry)

Co.No.	Year of Business		Policy Charged		Policy Form	Endorse	Policy Number	Amount of Risk	Class	Territory	State	City	Written Premium	Term in Mos.	Unearned Prem.	Unexpired Term in Months
	11	12	11	22												
00	0	0	10	20	0	0	0	0	0	0	0	0	0	0	0	0
11	1	1	1	11	1	1	1	1	1	1	1	1	1	1	1	1
22	2	2	2	12	2	2	2	2	2	2	2	2	2	2	2	2
33	3	3	3	13	3	3	3	3	3	3	3	3	3	3	3	3
44	4	4	4	14	4	4	4	4	4	4	4	4	4	4	4	4
55	5	5	5	15	5	5	5	5	5	5	5	5	5	5	5	5
66	6	6	6	16	6	6	6	6	6	6	6	6	6	6	6	6
77	7	7	7	17	7	7	7	7	7	7	7	7	7	7	7	7
88	8	8	8	18	8	8	8	8	8	8	8	8	8	8	8	8
99	9	9	9	19	9	9	9	9	9	9	9	9	9	9	9	9

13673

BURGLARY INSURANCE STATISTICS.

BURGLARY INSURANCE UNDERWRITERS ASSOCIATION

Co. No.	Year of Paid Business		Policy Form	Endorse	Claim Number	Amount of Risk	Class	Territory	State	City	Loss Paid	No. of Claims	Cause	Occupancy	Property	Ownership	Loss			
	11 Mo.	21 Yr.															11 Mo.	21 Yr.		
00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
22	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
33	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
44	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
55	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
66	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
77	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
88	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
99	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9

also show who owned the property. This is necessary because a separate rate is now charged for insurance on property belonging to the assured's guests, the policy itself covering only the property of all members of the assured's family who reside with him (with or without paying board or rent) and all other persons residing with him who do not pay board or rent, excluding domestic servants and other employees.

EXAMPLE.

Amount of Policy \$1,000.	Number of Policies Exposed for 1 Year.	Number of Months of Actual Exposure.	Losses.	Loss Cost per Policy per Year.
1 policy for 12 months.....	1	12	\$ 0	
1 policy for 36 months.....	3	36	27	
1 policy for 6 months.....	$\frac{1}{2}$	6	0	
	4 $\frac{1}{2}$	54	\$27	\$6.00

The only lines of burglary insurance on which it is necessary to segregate the experience according to the amounts or denominations of policies, are residence and mercantile open stock. This is necessary on these two lines because they both have been written for several years, by all companies at a rate which is higher for the first thousand than for the second, and higher for the second thousand than for the third, and so on up to \$5,000. For the excess amounts above \$5,000 the rate per thousand is uniform. The reason for this graduated scale is due to the fact that it is a difficult matter to induce policyholders to carry policies for sufficiently large amounts, so that the company will receive the premium on the actual value of property exposed to loss. The rate for the excess amounts is lower than for the first \$5,000 of insurance for the purpose of encouraging the assured to carry more insurance. Burglars, as a rule, carry away only a portion of the goods insured, although a sufficient quantity of goods is frequently stolen to make it necessary to pay the total amount of insurance under the policy. The average loss under a residence policy is about \$150, but we would like to know what the average loss is under each denomination of policy. For example, if it should develop that the average loss under \$1,000 policies is higher than under \$5,000 policies, the rate for a \$1,000 policy should be greater than the rate for the first \$1,000 of insurance under a \$5,000 policy.

The segregation of the experience as to location by state, territory and city is important because it is well known that burglaries occur more frequently in some cities than in others. The highest residence rates are for risks located in Chicago, Ill., and San Francisco, Cal. It was found some years ago that the loss ratio on residence business in those cities was so high that it was impossible to make a fair profit on the business. The lowest residence rates prevail in the New England States, although they have been reduced only recently in those states, outside of Massachusetts, the Massachusetts rates having been heretofore the lowest rates in the country.

About a year ago the country was divided into several so-called territories, for the purpose of rating residence risks, some of the companies believing that the volume of such business in the smaller towns was not growing rapidly enough because the rate was too high. In view of the fact that burglars usually make their headquarters in large centers of population, it was decided to place the larger cities in the territory taking the higher rate, and the smaller cities in the territory taking the lower rate, with what may be called special territories for certain cities and sections. A suburban town, for example, within twenty miles of New York City, because of its proximity to that city, is an attractive field for burglars who make their headquarters there and ply their trade in the smaller towns, returning to New York without inconvenience or delay. These territories are as follows:

TERRITORY No. 1.

Cook County, Ill., and the counties of San Francisco, Alameda and Los Angeles, Cal.

TERRITORY No. 2.

Greater New York, Long Island, Rockland and Westchester counties, N. Y., the Townships of New Canaan, Norwalk, South Norwalk, Greenwich, Stamford and Darien, Conn., and the entire state of New Jersey.

TERRITORY No. 3.

All cities having a population of 100,000 or more and not located in any other territory, also all counties containing cities of 100,000 population or more, not located in any other territory.

TERRITORY No. 4.

All cities and towns of less than 100,000 population except those located in other territories.

TERRITORY No. 5.

The New England States except that section of Connecticut located in Territory No. 2.

TERRITORY No. 6.

Kansas City, Mo., and Kansas City, Kans., and the State of California except that part of it which is located in Territory No. 1.

The experience under mercantile open stock or store policies will be furnished in a similar manner, but there are a great many more classifications as to the kind of property insured. There is only one form of mercantile open stock burglary policy, and this policy is not issued for a period of more than one year, but there are over two hundred classifications for the various kinds of merchandise insured.

The same information will be furnished as respects mercantile safe burglary policies, except that only two divisions are made as to the kind of property insured; money taking one classification and jewelry and similar merchandise the other. The safes are divided into two classes, fire-proof and burglar-proof.

The bank burglary data will show the number and amount of losses caused by robbers or hold-up men, separated from the number and amount of losses caused by the blowing open of the safe or vault by burglars. The amount of insurance under each classification of safe or vault arranged by states, territories and towns classified by population, may be used as a divisor to obtain the loss cost per \$1,000 of insurance per year. The system as devised will also make it possible to determine the loss cost per policy per year, arranged not only according to the class of safe or vault and territorial division, but also according to the various denominations of policies issued. The last mentioned data is not essential for rate making purposes as the rates for bank burglary policies are flat and not based on a graduated scale, but the information will be interesting and may be needed some time.

It is important that the experience on bank burglary business be arranged by states, because of the well-known fact that such burg-

larities are of common occurrence in some of the Western States, particularly in the Northwest and Southwest, and of infrequent occurrence in other parts of the country. It is also a well-known fact that bank burglaries usually occur in the smaller towns; the rate for this form of insurance being discounted according to the population of the town, the smaller the town, the smaller the discount.

The messenger and paymaster robbery rates and also the office or store robbery rates have caused considerable discussion in the Bureau because some companies think they should be high and others that they should be low, but no company has any means of knowing what rates are proper. The losses under messenger and paymaster robbery policies are comparatively few, but they are usually large, often wiping out the entire policy. The statistical data that the Bureau is now compiling on these lines will be of considerable value in determining what the rate ought to be.

Some of the companies prefer to furnish the data to the Bureau at regular intervals, in tabulated form, which is desirable because it reduces the Bureau expense that must necessarily be incurred in having the data on the written cards transferred to the punched cards, and then having the punched cards assorted and tabulated. From January 1, 1915 to July 1, 1915, the Bureau received approximately 89,144 exposure cards, and 288 loss cards. At this rate the number of cards for one year will be between 175,000 and 200,000, which is close to the Committee's original estimate of 200,000 cards per annum.

While one year's experience will be valuable for rate-making and other purposes, three years' experience will, naturally, be still more valuable and the segregation of the data in the manner outlined will show not only the loss cost as a whole, but also the loss cost on the various classes of property under the various coverages and conditions provided in the policies. It has been claimed by some companies that the rate ought to be divided, charging a higher rate under residence policies on jewelry and silverware, and a lower rate for clothing, and a still lower rate for miscellaneous articles. If such a division of the rate is deemed practical we can determine from the statistical data now being furnished, what each rate should be. This information will also make it possible to determine which coverage under the policy may be broadened and which should be restricted.

The twenty-six companies in the Bureau have indicated a willingness to co-operate in this work which is evidenced by the fact that they all are sending the necessary data to the Bureau, either on the written or punched cards, or in tabulated form.

The Bureau has several times been requested by the public authorities to furnish specific information respecting the number of burglaries in certain cities, the kind and value of goods stolen, and similar information. This information can be furnished under the present system if it is deemed advisable to use it for such purposes.

A SYSTEM OF ANALYZING WORKMEN'S COMPENSATION BUSINESS BY MEANS OF PERFORATED CARDS.

BY

E. E. CAMMACK.

The work usually hitherto undertaken by the statistical department of a casualty company writing compensation business may be divided into two general headings:

- (1) An analysis of business for annual statement requirements, which includes the classification of premiums written and losses paid
 - by states for computing taxes,
 - by agencies,
 - by policy years for computation of loss reserves, and also a continuous classification of premiums on policies in force by months of expiration for calculation of unearned premiums; and
- (2) An analysis by states of premiums written and payroll exposure and of losses, by trade classifications, compiled upon what is known as a policy-year basis.

With the change that has taken place in the nature of the business of casualty companies from employers' liability to workmen's compensation, it has now come to be realized that in addition to the compilation by states of a financial experience by trade classifications, an accident investigation should also be made. For the calculation of a scale of pure premiums for compensation insurance based upon the combined experience of states having compensation laws, it is necessary to know the accident rate by trade classifications with an analysis of the gravity of accidents and their resulting periods of disability. The Workmen's Compensation Service Bureau has promulgated a plan for combining the experience of companies writing compensation business who are members of the Bureau, from which it will be possible to deduce not only the pure premiums by trade classifications under the benefits provided by any particular state law, but also the accident frequency in different trades, analyzed by causes and results.

No attempt is made in this paper to outline in what form accident statistics should be compiled, or to deal with the difficult problem of the best method of treating outstanding claims in preparing a financial experience. The object of this paper is simply to outline the plan that the Aetna Life Insurance Company has adopted for classifying business for annual statement requirements, for analyzing premiums written, payroll exposure, and losses paid by trade classifications, and for collecting the data required by the Workmen's Compensation Service Bureau for an accident investigation.

The system of perforated cards is peculiarly adapted for compiling the statistics required by a casualty company. The Hollerith system of punched cards was adopted by the company with which I am associated for compiling its statistics over five years ago. The Hollerith sorting and tabulating machines are so well known amongst the statisticians of casualty companies that no explanation of them will be required. For any one who is not fully familiar with their working, reference can be made to a full description of the machines contained in a paper by Mr. Arthur Hunter on "Mortality Investigations by Perforated Cards" in Volume 11 of the Transactions of the Actuarial Society of America.

DESCRIPTION AND PREPARATION OF CARDS FOR ANALYSIS OF
PREMIUMS WRITTEN FOR ANNUAL STATEMENT
REQUIREMENTS.

It might be thought at first that one set of cards could be prepared for the whole of the premium analysis required, and this is the system adopted by some companies. It is my opinion, however, that work will be facilitated without increasing cost by preparing two sets of cards, one for the analysis of premiums written by states, agencies, policy years, and for computation of unearned premiums, etc., and the other set of cards for compiling financial experience by trade classifications. The actual number of cards to be punched will not be greatly increased in following this plan because it must be remembered that since every application contains on the average premiums for three or four different trade classifications, requiring the preparation of three or four experience cards, one for each trade classification, it will be necessary to prepare only one card for use in analyzing premiums for annual statement work unless the application is written for business carried on in more than one state.

ETNA LIFE INS. CO. ACCT. AND LIAB. DEPT.
Register Card.

0 0	0	H. O. No.	No. of Policies	E	LT	Premium	Agent	State	Policy Year	Return Premium	12 ENTERED		Date MO. DAY YR.	Date of POL.	Date of EXP.	Ledger	
											11	Mo. Day Yr.					
Lts.	5	10	7½	15	20	25	30	35	40	45	50	100	200				
				12	11	Mo. Yr.	P	ST	V	AV	GL	H	WC	C			
	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
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9

"Register" Card for Recording Original Premiums upon Applications.—On the opposite page is illustrated this card for analysis of original premiums for annual statement requirements. The printed headings of the columns upon the card are all self-explanatory with the following exceptions: the symbol "R" in the first column is punched to designate the card as being prepared from an application. In the second field the letters "Lts" stand for the limits of the policy. The symbols in the sixth field stand for the general class of business, as this card is used for analyzing Liability as well as Compensation premiums: "E" stands for Employers; "P," public; "V," teams; "AV," automobile; "GL," general liability; "H," elevator; "WC," workmen's collective; "C," compensation; and "D," physicians' liability. In the next field "LT" and "ST" stand for "Long Term" and "Short Term," in other words three-year and one-year policies; if a company writes business for other periods, a separate column would have to be provided for "Term of Policy." In the field headed "Entered," the date upon which the business is recorded is gang-punched each day. The reason for inserting the field headed "Return Premium" is explained later.

Cards are prepared in duplicate by clerks working independently, and upon one set the spaces on the left hand are filled in with pen and ink. This set is then filed away in numerical order. It is unnecessary to keep a book register of business written, as this set of cards will very conveniently replace such a record. The space marked "Ledger" in the corner of the card is used in checking typewritten cards, which are prepared from the applications for the accounts department for premium collection purposes. The duplicate punched cards are used for tabulation.

If the punched cards constitute the sole record of business written kept by a company, as is the case with the Aetna Life Insurance Company, it is essential that a proper check should be made of them.

CHECKING OF CARDS.

It is hardly necessary to state that there are two methods of checking perforated cards. The first is to punch a card and read it back with the copy from which it was prepared, and the second method is to have two cards punched by different operators and to compare them by placing them together and holding them up to the light, noting that the perforations on the cards are identical.

Additional and Refund Premium Card.
ETNA LIFE INS. CO. ACCIDENT AND LIAB. DEPT.
 Additional and Refund Premiums

JOURNAL Page	H. O. No.	No. of Policies	12 Expiry		E	LT	ST	Premium	Y Y Agent	State	Policy Year	Return Premium	Premium Cancelled	Premium Reinstated	12 Entered	
			Yr. Mo.	11											Yr. Mo.	11
0 0	0 0 0 0 0 0	0	0	0			0	0	0	0	0	0	0	0	0	0
R 1 1	1 1 1 1 1 1	1	1	1	AV	1	1	1	1	1	1	1	1	1	1	1
LT 2 2	2 2 2 2 2 2	2	2	2	GL	2	2	2	2	2	2	2	2	2	2	2
A 3 3	3 3 3 3 3 3	3	3	3	H	3	3	3	3	3	3	3	3	3	3	3
B 4 4	4 4 4 4 4 4	4	4	4	WC	4	4	4	4	4	4	4	4	4	4	4
C 5 5	5 5 5 5 5 5	5	5	5	C	5	5	5	5	5	5	5	5	5	5	5
D 6 6	6 6 6 6 6 6	6	6	6		6	6	6	6	6	6	6	6	6	6	6
E 7 7	7 7 7 7 7 7	7	7	7		7	7	7	7	7	7	7	7	7	7	7
8 8	8 8 8 8 8 8	8	8	8	D	8	8	8	8	8	8	8	8	8	8	8
99 9 9	9 9 9 9 9 9	9	9	9		9	9	9	9	9	9	9	9	9	9	9

The first method is usually adopted on the grounds that it is more economical. My own experience has been in the contrary direction. It is difficult to obtain a proper degree of accuracy without punching the cards in duplicate. Moreover, the punching of cards in duplicate by independent clerks takes very little longer than punching one set and "calling it back," and further, the duplicate set can usually be made to serve some other useful purpose. Furthermore, in such a case as that in which the punched card is the sole record of the amount of premiums written that a company keeps, accuracy is essential and by punching two sets of cards an additional check can be made of the amount of premiums written by running through the tabulator both sets of cards and noting that the premiums on each set are identical. Such a check as nearly eliminates errors in compiling the amount of business written as is possible.

Additional and Refund Premiums.—Record of these premiums can be made either upon vouchers or sheets. Upon these vouchers or sheets should be entered, in addition to the amount of the premium, the agent, state, policy year, term of policy, date of expiration, trade classification, payroll, and in the case of cancellations the amount of the original premium cancelled.

The illustration on the opposite page is of a card used for analyzing additional and refund premiums. The second and third columns on the card are provided for punching, for reference purposes, the number of the sheet from which the card is prepared. It will be noticed in this illustration that the card is exactly similar to the "Register" card from the third to the twenty-ninth columns, inclusive. This arrangement of columns is made so that the "Register" and "Additional and Refund Premium" cards may be sorted and tabulated together. The headings upon the card are all self-explanatory with the exception of the letters in the first column. In this column "LT" stands for renewals on policies written for a term of years by annual premiums, "A" for fully earned additional, "B" for miscellaneous additional, "C" for refunds on audits, "D" for refunds on cancelled policies, and "E" for refunds on not-taken policies. In the last field upon the card headed "Entered" is gang-punched the month and the year in which the business is recorded.

The provision on the card for two columns, one for "Premium" and another for "Return Premium," instead of providing only

ÆTNA LIFE INSURANCE COMPANY
ACCIDENT AND LIABILITY DEPARTMENT

State *Illinois*

Agent

1915	Premiums Written	Misc. Additionals	Additional Earned Premiums	Misc. Refund Premiums	Refund Premiums	Not Taken	Net Premiums
Jan.	\$10986.96	\$3935.34	\$1056.71	\$2440.74	\$180.80	\$2347.55	\$11009.92
Feb.	16637.31	2347.85	2204.03	1260.44	95.50	2858.01	16975.24
Mar.	13156.13	1822.55	3568.64	1535.38	230.25	2729.10	27985.16
Apr.							14052.59
May							42037.75
June							
July							
Aug.							
Sept.							
Oct.							
Nov.							
Dec.							

ANALYZING WORKMEN'S COMPENSATION BUSINESS.

one column, and denoting by punching a symbol as to whether the amount recorded thereon is a premium or a return premium, greatly facilitates the tabulation of results. A card punched "A," for example, with an amount in the "Return Premium" column designates a credit to additional earned premiums. A card punched "E" with an amount recorded in the "Premium" column designates a credit to not-taken premiums, in other words a reinstatement; and in this case the same amount would be punched in the "Premium Reinstated" column. In the case of a policy cancelled during its term, the authorized refund will be punched in the "Return Premium" column and the full premium cancelled in the "Premium Cancelled" column. In the case of a not-taken policy, the amount of the full premium will be punched both in the "Return Premium" and in the "Premium Cancelled" columns.

There are great advantages in tabulating gained by designing cards in this way. On classifications where all that is required is an analysis of net premiums written, all cards for original, additional, refund, and not-taken premiums may be sorted together according to the classification required. They will then be run through a tabulator furnished with two adding counters, the plugs on one counter being set for the "Premium" column and upon the other counter for the "Return Premium" column. Before transcribing the figures appearing upon the counters, the amount on the counter corresponding to the refund premiums is deducted mentally or otherwise from the amount appearing on the counter corresponding to the premium column, and the net result transcribed.

MONTHLY TABULATION OF CARDS.

It is my experience in compiling results that the best method for efficiency and accuracy is to compile the necessary classifications of business each month, transcribing the monthly totals directly from the tabulating machine counters to summary cards. An illustration is given on page 96 of a summary card for the analysis of premiums by states. If all the classifications that have to be made are drawn off every month, the cards can be packed away and stored, a plan that will effect considerable saving of space. If tabulation is made of six months' or a year's business at a time, much space is required for filing cards, considerable difficulties encountered in balancing results, and delay involved in compiling them.

If the course is adopted of tabulating at the beginning of each month all classifications of premiums recorded in the previous month that will eventually be required, it is very desirable to have a card so designed that corrections in the state, policy year, agency, expiration, etc., can be readily made. The device of having a column upon both the "Register" and "Additional and Refund Premium" cards for "Return Premium" as well as "Premium" facilitates changes in classifications that may be required on cards already tabulated. If, for example, it is required to change the state upon a premium for which a card has already been punched and tabulated, an adjustment in the tabulation of the premiums in the month in which the error is discovered can be readily made by punching a credit card for the data as originally recorded, and a new debit card with the correct data. For example, if it were discovered in February that the premium on an application charged in January had been assigned to New York, whereas the correct state was New Jersey, all that would be necessary to correct the error would be an adjustment in the tabulation of business recorded in February. This would be done by punching a "Register" card with the state as New York and the amount of premium punched in the "Return Premium" column, and a new card with the amount of premium punched in the "Premium" column for the state of New Jersey. The inclusion of these cards in tabulation with the cards for business recorded in February will automatically adjust the error.

COMPUTING UNEARNED PREMIUMS.

In tabulating the cards for classification of business arranged for computing unearned premiums, it is evident that cards punched "A" and "C," which are punched for additional and refunds charged after audits upon expirations of policies, need not be used. All that is necessary, therefore, is to tabulate together by months of expiration the difference between the amounts in the columns "Premium" and "Return Premium" upon cards punched "R," "LT," and "B" in the way just described to obtain the new business written to be added to the business in force, and to tabulate by months of expiration the difference between the amounts punched in the fields headed "Premiums Cancelled" and "Premiums Reinstated" upon the cards punched "D" and "E" to obtain the business cancelled, to be deducted from the business previously in

AETNA LIFE INSURANCE COMPANY

[Form 2341]

ACCIDENT AND LIABILITY DEPARTMENT

Class *Compensation*

	Expiration		Business in Force February 28, 1915		Business Written Month of March, 1915		Business Terminated Less Reinstatements Month of March, 1915		Business in Force March 31st, 1915		
	Year	Month	No.	Premiums	No.	Premiums	No.	Premiums	No.	Premiums	
	Policies Run- ning 1 Year	1915	Mch.	1563	\$126597.02			1563	\$126597.02		
April			1518	140894.88	17	\$1278.95	32	1836.69	1503	\$140337.14	
May			1369	127540.38	17	529.64	43	5820.39	1343	122249.63	
June			9567	660336.14	28	2387.72	292	19642.65	9303	643081.21	
July			3359	176298.71	17	3098.23	134	8308.93	3242	171088.01	
Aug.			1492	91916.88	9	919.07	53	2128.57	1448	90707.38	
Sept.			1436	95395.21	19	1138.87	43	2312.74	1412	94221.34	
Oct.			2082	155574.43	7	4242.74	39	7283.29	2050	152533.88	
Nov.			1251	98171.18	13	4000.55	32	2629.42	1232	99542.31	
Dec.			1246	126679.38	29	8327.69	46	4107.65	1229	130899.42	
1916			Jan.	4144	336467.92	161	25133.05	416	46237.88	3889	315363.09
			Feb.	1567	128841.65	461	40681.28	195	25315.44	1833	144207.49
		Mch.			2064	144120.40	67	11828.12	1997	132292.28	
				30594	\$2264713.78	2842	\$235858.19	2955	\$264048.79	30481	\$2236523.18
									Unearned	\$1022385.53	

ANALYZING WORKMEN'S COMPENSATION BUSINESS.

force. A sample of the sheet upon which the business written and cancelled, analyzed by months of expiration, is recorded is illustrated on page 99.

In passing it may be useful to describe a simple but convenient device for computing the actual unearned premiums, i. e., the actual unearned premiums on the assumption that policies are effected on the average in the middle of the month in which they are issued. A movable slip is prepared, as illustrated below, with lines at the same distance apart as those on the unearned premium reserve sheet, with the fractions $\frac{1}{24}$, $\frac{3}{24}$, $\frac{5}{24}$. . . $\frac{23}{24}$ entered one below the other, expressed in decimals.

VALUATION FACTORS.	
Premiums Expiring in	Fractions Unearned.
0- 1 month	.041667
1- 2 months	.125000
2- 3 months	.208333
3- 4 months	.291667
4- 5 months	.375000
5- 6 months	.458333
6- 7 months	.541666
7- 8 months	.625000
8- 9 months	.708333
9-10 months	.791667
10-11 months	.875000
11-12 months	.958333

This slip is placed beside a table of premiums upon policies in force classified by months of expiration, and the amount of premiums for each month is successively multiplied by the corresponding factor upon the slip by means of any standard calculating machine, the product after each multiplication has been made not being effaced from the machine. After the last multiplication has been made, the total on the face of the machine will be the computed amount of unearned premiums. Similar slips can be prepared for policies whose terms are 2, 3, 4, 5 years, etc.

ANALYSIS OF PREMIUM AND PAYROLL BY TRADE CLASSIFICATIONS.

A copy of the card used for analysis of written premiums and corresponding payrolls upon which they are based for investigating financial experience by trade classifications is shown on page 101. It differs from the card recommended by the Bureau in

ETNA LIFE INSURANCE COMPANY
Compensation Payroll Card

11		12		Date Pol.	Sch.	Class	Payroll	Premium	Rebate Payroll	Return Premium	Entered
Journal Page	H. O. No.	Date Pol.	Entered								
0 0	0 0 0 0	0 0	0 0	11 10	0 0	0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	11 0 0
R 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
LT 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
A 3	3 3 3 3	3 3	3 3	3 3	3 3	3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3
B 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
C 5	5 5 5 5	5 5	5 5	5 5	5 5	5 5	5 5 5 5	5 5 5 5	5 5 5 5	5 5 5 5	5 5 5 5
D 6	6 6 6 6	6 6	6 6	6 6	6 6	6 6	6 6 6 6	6 6 6 6	6 6 6 6	6 6 6 6	6 6 6 6
E 7	7 7 7 7	7 7	7 7	7 7	7 7	7 7	7 7 7 7	7 7 7 7	7 7 7 7	7 7 7 7	7 7 7 7
8 8	8 8 8 8	8 8	8 8	8 8	8 8	8 8	8 8 8 8	8 8 8 8	8 8 8 8	8 8 8 8	8 8 8 8
9 9	9 9 9 9	9 9	9 9	9 9	9 9	9 9	9 9 9 9	9 9 9 9	9 9 9 9	9 9 9 9	9 9 9 9

Card for Analysis of Business by Trade Classifications.

that a field is provided for the month in which insurance begins, to take care of the compilation of experience statistics brought up to intermediate dates of the year, as is sometimes required both by state departments and by the Bureau itself.

These cards are prepared directly from the applications and additional and refund premium sheets at the same time as the other cards already described, and the premiums are balanced on each set of cards. For tabulation, a four-counter tabulating machine will be required, as payroll, premium, rebate payroll, and return premium will be tabulated at the same time. It would not be feasible to analyze payroll and premium every month, because, owing to the large number of trade classifications, very few cards, when sorted, would fall in most of the groups to be tabulated. Analysis of these cards must be made at more extended intervals as may be found most convenient.

The Bureau has expressed to the companies a strong preference for having data furnished to it by perforated cards rather than by compiled results. No doubt there is good reason for this preference in reference to the furnishing of accident statistics, but as regards analysis of premiums written and payroll exposure by trade classifications, the question seems to me a different one. As regards accidents, the experience of individual companies will be too small to warrant, for each company, such a full analysis of its experience as may be made by the Bureau of the combined experience of all companies. As regards analysis of premiums written and payroll exposure by trade classifications, however, every company will have to undertake this for its own requirements, and it would seem a good course for the companies to send to the Bureau compiled results. Such results could be furnished on sheets or on perforated cards, one card for each policy year of the business (divided by states) for each trade classification. Such a course would save the Bureau much time by largely diminishing the number of cards to be handled.

ANALYSIS OF LOSSES.

An illustration is also given on page 103 of the card used for analysis of losses. The headings upon the card are all self-explanatory. The letter "L" in the eleventh column is punched to denote "Lump Sum Settlement." The code used for "Kind of Payment" is the code adopted by the Workmen's Compensation Service Bureau for a reason that is shown later.

ETNA LIFE INSURANCE COMPANY
Compensation Losses

12 Date of Pol.	12 Date of Acc.	Accident No.	12 L		Payment	Credit to Payment	Kind of Pay- ment	Policy Year	State	Y Y Agency X X	Sch.	Class	12 Entered	
			Yr.	Mo.									Yr.	Mo.
11	11													11
0	10	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	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0
1	11	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	12	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
3	13	3 3 3 3 3	3	3	3 3 3 3 3	3 3 3 3 3	3 3	3 3	3 3	3 3 3 3 3	3 3 3 3 3	3 3 3 3 3	3 3 3 3 3	3 3
4	14	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
5	15	5 5 5 5 5	5	5	5 5 5 5 5	5 5 5 5 5	5 5	5 5	5 5	5 5 5 5 5	5 5 5 5 5	5 5 5 5 5	5 5 5 5 5	5 5
6	16	6 6 6 6 6	6	6	6 6 6 6 6	6 6 6 6 6	6 6	6 6	6 6	6 6 6 6 6	6 6 6 6 6	6 6 6 6 6	6 6 6 6 6	6 6
7	17	7 7 7 7 7	7	7	7 7 7 7 7	7 7 7 7 7	7 7	7 7	7 7	7 7 7 7 7	7 7 7 7 7	7 7 7 7 7	7 7 7 7 7	7 7
8	18	8 8 8 8 8	8	8	8 8 8 8 8	8 8 8 8 8	8 8	8 8	8 8	8 8 8 8 8	8 8 8 8 8	8 8 8 8 8	8 8 8 8 8	8 8
9	19	9 9 9 9 9	9	9	9 9 9 9 9	9 9 9 9 9	9 9	9 9	9 9	9 9 9 9 9	9 9 9 9 9	9 9 9 9 9	9 9 9 9 9	9 9

Loss Card.

Changes in information regarding losses paid are frequently received. Any changes in the data concerning loss payments may readily be made by the use of the "Credit to Payment" column provided on the card, in precisely the same way in which it has been described that changes in the classification of premiums are made by use of a "Return Premium" column.

The loss cards are punched directly from loss vouchers, which are prepared in the claim department, and from them is drawn off each month an analysis of losses paid by states and agencies, and by policy years. Also at less frequent intervals, the necessary analysis of losses according to kinds of payment is made for compiling a financial experience by trade classifications.

The tabulated results of premiums written, payroll exposure, and losses paid are transferred to summary cards, an illustration of which is given on page 104.

ACCIDENT ANALYSIS.

In making an analysis of accidents by causes and results, the Aetna Life Insurance Company proposes to use the Hollerith cards designed by the Workmen's Compensation Service Bureau, samples of which for the sake of completeness are shown here on pages 106 and 107. There are two cards: one (the "Paid on Accident" card) is used for loss payments, and the other for recording cases upon which full settlement has not been made. The method adopted by the Bureau for making corrections in data concerning accidents already reported is to punch a "Credit" or "Contra" card in such a manner as to exactly duplicate the data recorded on the original card. The accident is then recorded as a new case with the correct data. The "Credit" or "Contra" cards are distinguished by their color. They will, of course, have to be tabulated and sorted separately, and the results deducted from the results obtained from the tabulation of the "Paid on Accident" cards. A complete description of these cards with sets of codes has been prepared by the Workmen's Compensation Service Bureau, and there will be stated here only the method for collecting data from which to punch them.

When an accident is reported, it is given a serial number, and as full particulars as are available are entered upon an "Accident Analysis" card, a copy of which is shown on page 108. The data is recorded by means of code numbers from the codes prepared by the Bureau. The duration of disability, when an acci-

WORKMEN'S COMPENSATION SERVICE BUREAU
Paid on Accident. (Color E.)

YYY Designating No. XXX	State E	Classifica- tion	22 Dec. Acct. Date	F Sex M	Age Yr.	Y	MEDICAL PAID		Cause of Injury X	E Nature of Injury L	Wkly Wage	DURATION OF INJ. Weeks	Y	COMPENSATION PAID		Counter
							Dollars X	Cents						Dollars	Cents	
0 0 0	0 0 0	0 0 0	20 Oct.	I	0	0	0 0 0	0 0 0	X	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	11 Jan.	1	1	1	1 1 1	1 1 1	X	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	0
2 2 2	2 2 2	2 2 2	12 Feb.	2	2	2	2 2 2	2 2 2	X	2 2 2	2 2 2	2 2 2	2 2 2	2 2 2	2 2 2	2
3 3 3	3 3 3	3 3 3	13 Mar.	3	3	3	3 3 3	3 3 3	X	3 3 3	3 3 3	3 3 3	3 3 3	3 3 3	3 3 3	3
4 4 4	4 4 4	4 4 4	14 Apr.	4	4	4	4 4 4	4 4 4	X	4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	4 4 4	4
5 5 5	5 5 5	5 5 5	15 May	5	5	5	5 5 5	5 5 5	X	5 5 5	5 5 5	5 5 5	5 5 5	5 5 5	5 5 5	5
6 6 6	6 6 6	6 6 6	16 Jun.	6	6	6	6 6 6	6 6 6	X	6 6 6	6 6 6	6 6 6	6 6 6	6 6 6	6 6 6	6
7 7 7	7 7 7	7 7 7	17 July	7	7	7	7 7 7	7 7 7	X	7 7 7	7 7 7	7 7 7	7 7 7	7 7 7	7 7 7	7
8 8 8	8 8 8	8 8 8	18 Aug.	8	8	8	8 8 8	8 8 8	X	8 8 8	8 8 8	8 8 8	8 8 8	8 8 8	8 8 8	8
9 9 9	9 9 9	9 9 9	19 Sept.	9	9	9	9 9 9	9 9 9	X	9 9 9	9 9 9	9 9 9	9 9 9	9 9 9	9 9 9	9

Workmen's Compensation Service Bureau's "Paid on Accident" Card.

WORKMEN'S COMPENSATION SERVICE BUREAU
Outstanding. (Color A.)

YYY Designating No.	State	Classification	22 Dec. Acct. Date	F Sex M Imp %	Y Age X Grp.	Y Out- standing Dollars Only	Y Cause of Injury L	R Nature of Injury L	W'ly Wage	Est. Out- standing Duration Weeks Only	WEEKLY BENEFIT Dollars Cents	COMPUTED RESERVE Kind of Pay- ment	Counter
000	0	0	20	0	0	0	0	0	0	0	0	0	0
111	1	1	11	1	1	1	1	1	1	1	1	1	1
222	2	2	12	2	2	2	2	2	2	2	2	2	2
333	3	3	13	3	3	3	3	3	3	3	3	3	3
444	4	4	14	4	4	4	4	4	4	4	4	4	4
555	5	5	15	5	5	5	5	5	5	5	5	5	5
666	6	6	16	6	6	6	6	6	6	6	6	6	6
777	7	7	17	7	7	7	7	7	7	7	7	7	7
888	8	8	18	8	8	8	8	8	8	8	8	8	8
999	9	9	19	9	9	9	9	9	9	9	9	9	9

Worker's Compensation Service Bureau's Outstanding Card.

COMPENSATION—Accident Analysis

Accident Number			Claim Number			State		Policy Year		MEDICAL PAYMENTS		
AETNA LIFE		Basic Manual Class No.	DATE OF ACCIDENT		Sex	Degree of Impairment	Age Group	Mark X if fees not strictly medical	YEAR PAID			
Sched. No.	Class No.		Year	Month								
INJURY										COMPENSATION PAYMENTS		
MACHINE			CAUSE	NATURE		WEEKLY WAGES	KIND	DURATION		YEAR PAID	KIND	AMOUNT
Manner of Occurrence	Enter X if acc. at point opera- tion	Enter Y if acc. due to ma- chine const.		Enter R if right side	Enter L if left side			Days	Days			
REMARKS (If fatal case show dependents, etc.)												
Accident Analysis Card												

dent results in disability, is entered when the final payment on the claim is made. Once a year, before the Bureau accident cards are punched from this record, a review is made of all the cards with the claim papers. After this has been done, medical fees paid and compensation paid for the previous year are recorded, the information being drawn from the perforated loss cards already described by sorting these into numerical order by accident numbers, and tabulating from them upon the "Accident Analysis" cards the amounts paid according to kinds of payment. The Bureau cards will be punched in duplicate with the view of sending one set to the Bureau, and retaining the other set for the company's own use.

It is hoped that the foregoing brief description of a method of compiling statistics may be of assistance to those who have not as yet introduced into their offices the system of perforated cards, and to others who have not completed their plans for best furnishing to the Workmen's Compensation Service Bureau the data it requires for a comprehensive accident investigation.

TABLES FOR COMPUTING THE PRESENT VALUE OF
DEATH BENEFITS ARISING UNDER THE NEW
YORK WORKMEN'S COMPENSATION LAW.

BY

RICHARD FONDILLER.

The death benefits (in addition to the funeral benefit) under the New York Workmen's Compensation Law, which went into effect July 1, 1914, may be briefly stated as follows:

1. To the widow (or dependent husband) 30 per cent. of the wages of the deceased employee, until death; upon remarriage, the pension ceases and two years' compensation is paid in one sum.

2. To each child, until it reaches the age of 18, 10 per cent. of the wages, the widow being alive, or 15 per cent., the widow being dead.

3. To parents or grandparents, for life, 15 per cent. of the deceased's wages.

4. To brothers, sisters or grandchildren, until age 18, 15 per cent. of the wages.

NOTE: THE TOTAL AMOUNT OF COMPENSATION PAYABLE MUST NOT EXCEED $66\frac{2}{3}$ PER CENT. OF THE DECEASED'S WAGES, AND THE MAXIMUM AMOUNT UPON WHICH COMPENSATION IS PAYABLE IS \$1,200.

The New York State Industrial Commission has adopted for purposes of valuation and commutation the Danish Survivorship Annuitants' Table of Mortality* with $3\frac{1}{2}$ per cent. interest, and the Remarriage Table of the Dutch Royal Insurance Institution.* These standards are used for the valuation of death claims in the State Insurance Fund. They are also in use for the calculation of the present values of awards where commutation is granted by the Commission.

The appended tables have been computed in the actuarial department of the Commission, under the supervision of Mr. Joseph H. Woodward, to whom the writer is indebted for valuable suggestions as to the form of this paper. Mr. Harry Lubin computed Table II and Mr. Vincent G. McGuire assisted in calculating the

* Also adopted by the New York Insurance Department for mutual compensation companies.

data upon which all of the tables are based. The law provides for the pension to be payable in the same manner as the deceased received his wages, and at the present time the Commission is ordering pensions to be paid weekly. In effect, payments are being made at frequent intervals throughout the year and the valuation is therefore made on the basis of a continuous annuity, i. e., an annuity assumed to be payable continuously or momentarily.

NOTATION.

x = age of widow.

y_1 = age of eldest child, y_2 the next eldest, etc.

z_1 = age of eldest of dependent brothers, sisters or grandchildren, z_2 the next eldest, etc.

w_1 = age of eldest dependent parents or grandparents, w_2 the next eldest, etc.

\bar{a}_x , the present value of \$1 per annum, payable momentarily, and ceasing at death or remarriage.

\bar{E}_x , the present value of \$1 payable at remarriage.

$\bar{a}_{y \overline{18-y}|}$, the present value of \$1 per annum, payable momentarily, and ceasing at age 18.

\bar{a}_w , the present value of \$1 per annum, payable momentarily, and ceasing at death.

ILLUSTRATIONS OF USES OF TABLES.

Example 1.—Dependents: widow, aged 37, and children, aged 13, 6 and 1. Annual wage of deceased employee, \$720.

The benefit in this case is

$$7.2 [(30\bar{a}_{37} + 60\bar{E}_{37}) + (15\bar{a}_{13 \overline{6}|} - 5\bar{a}_{37:13 \overline{6}|}) + (15\bar{a}_{6 \overline{12}|} - 5\bar{a}_{37:6 \overline{12}|}) + (15\bar{a}_{1 \overline{17}|} - 5\bar{a}_{37:1 \overline{17}|})]$$

$$= 7.2 \left[\begin{array}{cccc} \text{Table I} & \text{Table II} & \text{Table II} & \text{Table II} \\ (469.35) & + (45.71) & + (97.29) & + (127.06) \end{array} \right]$$

= 7.2 (739.41) = \$5,323.75 Total present value.

The work may be arranged in tabular form as follows:

Table No.	Dependent.	Age.	Present Value of \$100 Wage.	Multiplier.	Present Value.
I	Widow	37	\$469.35	7.2	\$3,379.32
II	Child	13	45.71	7.2	329.11
II	"	6	97.29	7.2	700.49
II	"	1	127.06	7.2	914.83
				Total.....	\$5,323.75

Example 2.—Dependents: children, aged 15, 12, 7 and 2. Annual wage of deceased employee, \$1,050.

The benefit in this case is

$$10.5 (15\bar{a}_{15|\overline{3}|} + 15\bar{a}_{12|\overline{6}|} + 15\bar{a}_{7|\overline{11}|} + 15\bar{a}_{2|\overline{18}|})$$

From Table III

$$= 10.5 (42.44 + 80.10 + 133.76 + 177.78)$$

$$= 10.5 (434.08) = \$4,557.84 \text{ Total present value.}$$

The work may be arranged in tabular form as follows:

Table No.	Dependent.	Age.	Present Value of \$100 Wage.	Multiplier.	Present Value.
III	Child	15	\$ 42.44	10.5	\$ 445.62
III	"	12	80.10	10.5	841.05
III	"	7	133.76	10.5	1,404.48
III	"	2	177.78	10.5	1,866.69
				Total.....	\$4,557.84

Example 3.—Dependents: grandparents, aged 84 and 79, and parents, aged 52 and 48. Annual wage of deceased employee, \$1,200.

The benefit in this case is

$$12 (15\bar{a}_{84} + 15\bar{a}_{79} + 15\bar{a}_{52} + 15\bar{a}_{48})$$

From Table IV

$$= 12 (55.95 + 77.22 + 222.70 + 241.78)$$

$$= 12 (597.65) = \$7,171.80 \text{ Total present value.}$$

The work may be arranged in tabular form as follows:

Table No.	Dependent.	Age.	Present Value of \$100 Wage.	Multiplier.	Present Value.
IV	Grandparent	84	\$ 55.95	12	\$ 671.40
IV	"	79	77.22	12	926.64
IV	Parent	52	222.70	12	2,672.40
IV	"	48	241.78	12	2,901.36
				Total.....	\$7,171.80

Example 4.—Dependents: widow, aged 26, child, aged 5, and grandparent, aged 73. Annual wage of deceased employee, \$1,130.

The benefit in this case is

$$11.3 [(30\bar{a}_{26} + 60\bar{E}_{26}^{\overline{v}}) + (15\bar{a}_{5|\overline{13}|} - 5\bar{a}_{26;5|\overline{13}|}) + (15\bar{a}_{73})]$$

$$= 11.3 \left[\begin{array}{ccc} \text{Table I} & \text{Table II} & \text{Table IV} \\ (356.34) & + & (103.30) + (107.38) \end{array} \right]$$

$$= 11.3 (567.02) = \$6,407.33 \text{ Total present value.}$$

The work may be arranged in tabular form as follows:

Table No.	Dependent	Age.	Present Value of \$100 Wage.	Multiplier.	Present Value.
I	Widow	26	\$356.34	11.3	\$4,026.64
II	Child	5	103.30	11.3	1,167.29
IV	Grandparent	73	107.38	11.3	1,213.40
				Total.....	\$6,407.33

Example 5.—Dependents: widow, aged 40, children, aged 16 and 10, and parent, aged 68. Annual wage of deceased employee, \$910.50.

The benefit in this case is

$$\begin{aligned}
 & 9.105[(30\bar{a}_{40'} + 60\bar{E}_{40'}) + (15\bar{a}_{16\bar{2}} - 5\bar{a}_{40:16\bar{2}}) \\
 & \quad + (15\bar{a}_{10\bar{2}} - 5\bar{a}_{40:10\bar{2}}) + (15\bar{a}_{68})] \\
 & = 9.105 \left[\begin{array}{cccc} \text{Table I} & \text{Table II} & \text{Table II} & \text{Table IV} \end{array} \right] \\
 & = 9.105 [(481.89) + (19.30) + (69.48) + (135.03)] \\
 & = 9.105 (705.70) = \$6,425.40 \quad \text{Total present value.}
 \end{aligned}$$

The work may be arranged in tabular form as follows:

Table No.	Dependent.	Age.	Present Value of \$100 Wage.	Multiplier.	Present Value.
I	Widow	40	\$481.89	9.105	\$4,387.61
II	Child	16	19.30	9.105	175.73
II	"	10	69.48	9.105	632.62
IV	Parent	68	135.03	9.105	1,229.44
				Total.....	\$6,425.40

Age of Annuitant.—In order to secure the correct value, it is advisable to ascertain the date of birth of all annuitants and then to take the age at nearest birthday as the age on the date that the present value is desired. For example: If an employee were killed on May 24, 1915, and his widow was born on August 15, 1870, her age must be taken as 45 if it is desired to compute the value as of date of death. In valuation, assume that six months after the date of death, the ages of all dependents increase one year. If a valuation is being made as of December 31, 1918, the attained age of the widow, 49, should be used. Similar principles are applicable to all classes of annuitants.

TABLE II.
CHILD, DURING LIFE OF WIDOW.
Present Value of Pension per \$100 Wage, Payable until Age 18.

$$15\bar{a}_{y:\overline{18-y}|} - 5\bar{a}_{x:y:\overline{18-y}|}$$

Age of Widow (x).	Age of Child (y).																	Age of Widow (x).	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		17
15	131.40																		15
16	131.41	126.18																	16
17	131.42	126.18	120.75																17
18	131.44	126.20	120.76	115.12															18
19	131.46	126.22	120.77	115.13	109.28														19
20	131.48	126.24	120.79	115.14	109.29	103.22													20
21	131.49	126.26	120.81	115.16	109.30	103.23	96.92												21
22	131.51	126.26	120.83	115.18	109.32	103.24	96.93	90.40											22
23	131.53	126.29	120.83	115.20	109.34	103.25	96.94	90.41	83.62										23
24	131.56	126.32	120.86	115.21	109.36	103.27	96.95	90.42	83.63	76.59									24
25	131.59	126.34	120.88	115.23	109.36	103.29	96.97	90.43	83.64	76.60	69.27								25
26	131.63	126.37	120.90	115.26	109.38	103.30	96.98	90.44	83.65	76.61	69.27	61.69							26
27	131.67	126.41	120.94	115.29	109.41	103.32	96.98	90.46	83.66	76.62	69.28	61.69	53.82						27
28	131.72	126.45	120.97	115.31	109.43	103.34	97.00	90.46	83.67	76.63	69.29	61.70	53.83	45.66					28
29	131.77	126.49	121.01	115.35	109.46	103.36	97.02	90.48	83.68	76.63	69.30	61.71	53.83	45.67	37.19				29
30	131.82	126.54	121.05	115.39	109.49	103.39	97.04	90.50	83.69	76.63	69.31	61.72	53.83	45.67	37.20	28.41			30
31	131.87	126.59	121.10	115.43	109.53	103.42	97.07	90.52	83.71	76.64	69.32	61.73	53.84	45.68	37.20	28.41	19.29		31
32	131.93	126.66	121.15	115.47	109.57	103.45	97.10	90.54	83.73	76.66	69.32	61.74	53.85	45.68	37.20	28.41	19.29	9.83	32
33	132.01	126.72	121.20	115.51	109.61	103.49	97.13	90.57	83.75	76.68	69.34	61.74	53.86	45.69	37.21	28.41	19.29	9.83	33
34	132.09	126.79	121.27	115.57	109.65	103.53	97.16	90.60	83.77	76.70	69.36	61.76	53.86	45.69	37.21	28.42	19.29	9.83	34
35	132.18	126.87	121.34	115.64	109.71	103.58	97.20	90.63	83.80	76.72	69.37	61.77	53.88	45.70	37.21	28.42	19.29	9.83	35
36	132.29	126.96	121.42	115.71	109.77	103.63	97.24	90.66	83.82	76.74	69.39	61.78	53.88	45.70	37.22	28.42	19.29	9.83	36
37	132.41	127.06	121.50	115.78	109.83	103.68	97.29	90.70	83.86	76.76	69.41	61.80	53.90	45.71	37.23	28.43	19.29	9.83	37
38	132.53	127.17	121.60	115.87	109.91	103.74	97.34	90.74	83.90	76.80	69.43	61.82	53.91	45.72	37.23	28.43	19.29	9.84	38
39	132.70	127.29	121.71	115.96	109.99	103.81	97.40	90.80	83.94	76.82	69.46	61.84	53.92	45.73	37.23	28.43	19.30	9.84	39
40	132.82	127.44	121.82	116.06	110.08	103.88	97.46	90.85	83.98	76.86	69.48	61.86	53.94	45.74	37.24	28.44	19.30	9.84	40

Age of Widow (2).	Age of Child (y).																	Age of Widow (2).	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		17
41	133.00	127.57	121.96	116.17	110.17	103.97	97.54	90.90	84.02	76.90	69.52	61.88	53.96	45.75	37.25	28.44	19.30	9.84	41
42	133.17	127.74	122.10	116.30	110.28	104.06	97.62	90.98	84.08	76.94	69.55	61.90	53.98	45.76	37.25	28.44	19.30	9.84	42
43	133.37	127.92	122.26	116.44	110.40	104.16	97.70	91.04	84.14	76.99	69.58	61.93	54.00	45.78	37.27	28.45	19.31	9.84	43
44	133.60	128.12	122.44	116.59	110.53	104.28	97.80	91.12	84.20	77.04	69.63	61.96	54.02	45.80	37.27	28.46	19.31	9.84	44
45	133.83	128.34	122.63	116.77	110.68	104.40	97.90	91.22	84.28	77.10	69.68	62.00	54.04	45.82	37.29	28.46	19.31	9.84	45
46	134.05	128.58	122.85	116.95	110.85	104.54	98.02	91.32	84.36	77.17	69.72	62.04	54.07	45.84	37.30	28.47	19.31	9.84	46
47	134.33	128.86	123.58	117.16	111.03	104.70	98.16	91.42	84.45	77.24	69.78	62.08	54.10	45.86	37.31	28.48	19.31	9.84	47
48	134.57	128.86	123.34	117.39	111.22	104.87	98.30	91.54	84.55	77.32	69.84	62.13	54.14	45.88	37.33	28.49	19.32	9.84	48
49	134.85	129.15	123.34	117.64	111.44	105.06	98.46	91.68	84.66	77.41	69.92	62.18	54.18	45.91	37.35	28.50	19.33	9.84	49
50	135.13	129.48	123.64	117.64	111.69	105.26	98.64	91.82	84.78	77.51	70.00	62.24	54.22	45.94	37.37	28.51	19.33	9.84	50
51	.....	129.83	123.94	117.92	111.69	105.50	98.83	91.99	84.92	77.62	70.08	62.31	54.27	45.97	37.39	28.52	19.33	9.84	51
52	.....	.....	124.30	118.23	111.95	105.50	99.04	92.17	85.06	77.74	70.18	62.38	54.32	46.00	37.41	28.54	19.34	9.84	52
53	.....	.....	.....	118.56	112.24	105.75	99.04	92.37	85.23	77.87	70.28	62.46	54.38	46.04	37.43	28.55	19.35	9.84	53
54	.....	.....	.....	.....	112.57	106.02	99.28	92.37	85.41	78.02	70.40	62.55	54.44	46.10	37.47	28.56	19.35	9.84	54
55	.....	.....	.....	.....	.....	106.33	99.54	92.59	85.41	78.18	70.52	62.65	54.52	46.14	37.50	28.58	19.37	9.85	55
56	.....	.....	.....	.....	.....	.....	99.83	92.83	85.61	78.18	70.66	62.76	54.60	46.20	37.53	28.60	19.37	9.85	56
57	.....	.....	.....	.....	.....	.....	.....	93.10	85.83	78.36	70.66	62.88	54.68	46.26	37.57	28.62	19.38	9.86	57
58	.....	.....	.....	.....	.....	.....	.....	.....	86.08	78.56	70.82	62.88	54.78	46.33	37.61	28.65	19.39	9.86	58
59	.....	.....	.....	.....	.....	.....	.....	.....	.....	78.78	71.00	63.01	54.78	46.40	37.67	28.67	19.41	9.86	59
60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	71.18	63.16	54.89	46.40	37.72	28.70	19.42	9.86	60
61	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	63.32	55.01	46.48	37.72	28.74	19.43	9.86	61
62	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	55.14	46.58	37.77	28.74	19.45	9.87	62
63	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	46.68	37.85	28.78	19.45	9.88	63
64	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	37.91	28.82	19.47	9.88	64
65	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	28.86	19.49	9.88	65
66	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	19.51	9.89	66
67	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9.90	67

PRESENT VALUE OF DEATH BENEFITS.

TABLE I.

WIDOW OR WIDOWER.

Present Value of Pension per \$100 Wage, Payable till Death or Remarriage.

$$30\bar{a}_{x'} + 60\bar{E}_{x'}.$$

Age (x)	Present Value.	Age (x).	Present Value.
15	260.97	40	481.89
16	266.55	41	483.66
17	272.73	42	484.26
18	279.54	43	483.69
19	286.02	44	482.07
20	294.96	45	479.43
21	303.72	46	475.83
22	313.14	47	471.36
23	323.16	48	466.02
24	333.75	49	459.96
25	344.76	50	453.18
26	356.34	51	445.83
27	368.10	52	437.85
28	380.07	53	429.45
29	392.04	54	420.51
30	403.86	55	411.15
31	415.38	56	401.46
32	426.42	57	391.44
33	436.83	58	381.12
34	446.43	59	370.56
35	455.13	60	359.82
36	462.81	61	348.87
37	469.35	62	337.80
38	474.72	63	326.61
39	478.92	64	315.33
		65	304.02

TABLE III.

CHILD, THE WIDOW BEING DEAD; BROTHER, SISTER OR GRANDCHILD.

Present Value of Pension per \$100 Wage, Payable until Age 18.

$$\bar{a}_{\overline{18-y}|}$$

Age (y).	Present Value.	Age (y).	Present Value.
0	193.10	10	102.84
1	185.60	11	91.70
2	177.78	12	80.10
3	169.66	13	68.04
4	161.20	14	55.48
5	152.42	15	42.44
6	143.26	16	28.84
7	133.76	17	14.72
8	123.86		
9	113.56		

TABLE IV.

PARENT OR GRANDPARENT.

Present Value of Pension per \$100 Wage, Payable until Death. \bar{a}_w .

Age (w).	Present Value.	Age (w).	Present Value.	Age (w).	Present Value.
0	356.40	35	292.06	70	123.80
1	355.48	36	288.82	71	118.26
2	354.54	37	285.50	72	112.78
3	353.55	38	282.06	73	107.38
4	352.53	39	278.52	74	102.08
5	351.46	40	274.88	75	96.87
6	350.36	41	271.11	76	91.77
7	349.22	42	267.26	77	86.79
8	348.02	43	263.28	78	81.93
9	346.77	44	259.20	79	77.22
10	345.50	45	255.00	80	72.64
11	344.14	46	250.71	81	68.24
12	342.76	47	246.30	82	63.98
13	341.32	48	241.78	83	59.88
14	339.82	49	237.16	84	55.95
15	338.26	50	232.46	85	52.20
16	336.66	51	227.62	86	48.62
17	334.98	52	222.70	87	45.21
18	333.26	53	217.70	88	41.98
19	331.46	54	212.58	89	38.94
20	329.58	55	207.39	90	36.06
21	327.64	56	202.12	91	33.36
22	325.64	57	196.77	92	30.82
23	323.55	58	191.34	93	28.46
24	321.40	59	185.86	94	26.25
25	319.17	60	180.33	95	24.20
26	316.84	61	174.74	96	22.30
27	314.46	62	169.11	97	20.56
28	311.97	63	163.44	98	18.94
29	309.40	64	157.77	99	17.48
30	306.75	65	152.07	100	16.14
31	304.00	66	146.37	101	14.92
32	301.16	67	140.68	102	13.83
33	298.23	68	135.03	103	12.81
34	295.20	69	129.39	104	11.85
				105	9.80
				106	7.50

The younger ages are included, for the sake of completeness.

Note.—Where the total compensation exceeds 66 2/3 per cent., a deduction must be made, the actuarial principles of which are fully treated in the papers contained in the following bibliography.

BIBLIOGRAPHY.

- Valuation of the Death Benefits provided by the New York Compensation Law, by Winfield W. Greene, *Proceedings*, Vol. I, page 31.
- Workmen's Compensation Claim Reserves, by Miles M. Dawson, *Proceedings*, Vol. I, page 90.
- Workmen's Compensation Reserves, by Joseph H. Woodward, *Proceedings*, Vol. I, page 112.
- Mortality Table for Female Beneficiaries in Survivorship Annuities, by Christian Jensen, *Transactions of the Actuarial Society of America*, Vol. X, page 253.
- Extension of Female Survivorship Annuitant Tables, by Miles M. Dawson, *Transactions of the Actuarial Society of America*, Vol. XI, page 451.
- Mortality and Remarriage Tables for Valuation of Compensation to Widows and other Dependents, by Miles M. Dawson, *Transactions of the Actuarial Society of America*, Vol. XV, page 306.
- Valuation of the Death Benefits provided by the Workmen's Compensation Law of New York, by Edward Olifiers, *Transactions of the Actuarial Society of America*, Vol. XVI, page 83.

A NEW GRAPHIC METHOD OF USING THE NORMAL PROBABILITY CURVE.

BY

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If the logarithms of the ordinates of the normal probability curve are platted to the natural values of x , the ends of the familiar curve droop down to infinity and the curve becomes a parabola, as is seen by writing the equation of the normal probability curve

$$y = \frac{n}{s\sqrt{2\pi}} e^{-(x^2/2s^2)}$$

and taking logarithms of both sides

$$\log y = \log \frac{n}{s\sqrt{2\pi}} - \frac{x^2}{2s^2}$$

or

$$\log y = k - \frac{x^2}{2s^2}$$

and putting $u = \log. y$

$$u = k - \frac{x^2}{2s^2}$$

a parabola with its vertex at $\begin{matrix} u = k \\ x = 0 \end{matrix}$.

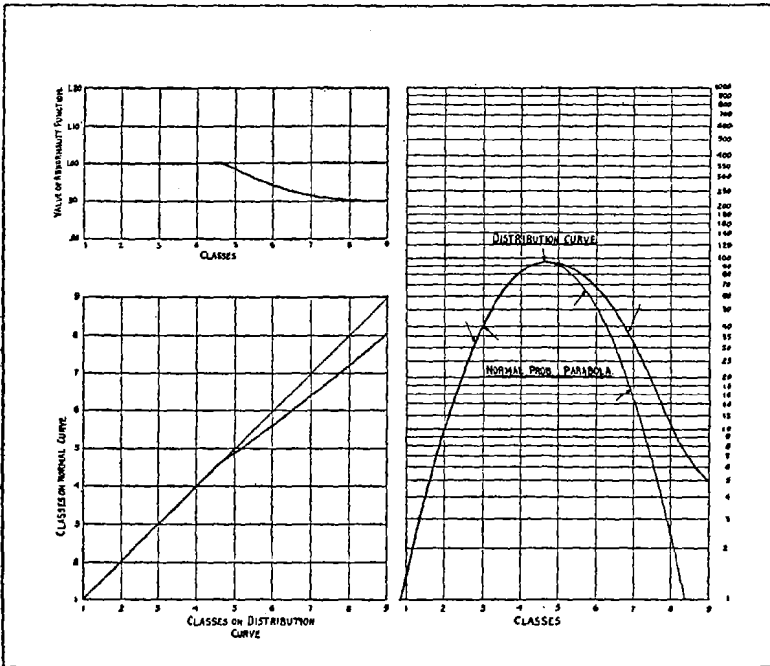
The advantage of plating distribution curves on paper ruled with equal spacing of the vertical lines and logarithmic spacing of the horizontal lines, is that if the distribution curve is normal it is a parabola, and if after plating a moderate number of individuals we draw in the parabola fitting the tops of the ordinates, and then continue plating more and more individuals, the same parabola continues to fit the tops of the ordinates; it merely moves up, the parameter of the parabola remaining constant. In fact the parameter of the parabola is a measure of the spread of the distribution.

* Presented by Albert W. Whitney.

Since five points determine a parabola, it is possible to use fewer classes; in fact, seven or nine classes are usually enough. One set of parabolic templates then will fit all normal distributions.

If we wish to study non-normal distribution curves, the utility of the equal spaced x , logarithmic y paper is seen.

Let me take the distribution of English words into classes of one, two, three, four, etc., letters per word. As we plot the curve we may stop at any time and try a parabolic template. We see that the characteristic shape develops early. We note that as we go on



taking words, we do not have to change templates, the same one is merely moved up.

We find, however, that while the left limb of the curve and its top is easy to fit, the right limb is too high.

Let us fit the parabola as best we can, and draw it in, and count the individuals included between the distribution curve and the parabola, and replat them as a residual curve. Again we have a parabola, but of different parameter, and with its axis to the right of the axis of the first parabola.

We have resolved the distribution curve into two normal probability curves. Many irregular distribution curves may be resolved into two or more normal curves, and in certain cases such resolution may have real meaning, but not always, just as we may resolve certain periodic curves by the Fourier Analysis into a series of sine curves which do not have any real meaning at all—I am thinking of pulse blood pressure curves.

Suppose we have a number of objects to be classified according to some measurable characteristic, and let us suppose the distribution curve is not normal, but that when we measure some other characteristic in the same lot of individuals, we do get a normal curve, or let us suppose that (since we do not suspect any progressive or cumulative change in mode or plurality of modes) we suspect there may be some characteristic which will distribute the objects normally. Then we may find what function of that characteristic the characteristic is which we used, as follows.

Plot and obtain a non-normal distribution curve for the classification according to the characteristic chosen. Fit the parabola that will most nearly cover the most normal half of the experimental curve, and draw in this parabola. The method is indicated in the figure.

The abnormal distribution curve suggests the following. Suppose we make the statement that if a sufficient number of objects have been produced by causes which, while variable, independently, during the production of the objects have not varied cumulatively; these objects may be sorted into class groups whose class magnitudes (not the number of objects in the class) are arranged in arithmetical progression, and the number of objects in the class groups will form a distribution curve capable of being resolved into as many normal probability curves as there were independent causes, whatever be the characteristic which was chosen for measurement.

The question lies in the use of the word "arithmetical progression." It may be that this is only a special case, and that the more general case is that of a series in which each difference is an equal part of the class magnitude at that point, that is to say, a logarithmic axis of x , where the total range of class magnitudes is but a small fraction of the mean class magnitude. This becomes the arithmetical series in the limit.

In the more intractable case, where the causes are changing cumulatively, the logarithmic plating of either y , or y and x has not seemed to be of so much help.

Mr. W. G. Housekeeper, of the Western Electric Physical Laboratory, has collaborated with me in this work, which was suggested by his exhaustive study and analysis of the measurements of the electrical and photometric characteristics of the miniature electric lamps manufactured by the Western Electric Company for use in telephone switchboards.

THE DETERMINATION OF PURE PREMIUMS FOR MINOR
CLASSIFICATIONS ON WHICH THE EXPERIENCE
DATA IS INSUFFICIENT FOR DIRECT
ESTIMATE.

BY

A. H. MOWBRAY.

In the several papers in our PROCEEDINGS and in the TRANSACTIONS OF THE ACTUARIAL SOCIETY OF AMERICA dealing with compensation premium or rate making, the starting point has been a classification pure premium derived by the well-known formula, $\pi = L/P$. It has been generally recognized that it will be impossible to determine the pure premiums in this way for each classification, and that some process of association must be resorted to in order to develop premiums for those classifications where the data is insufficient.*

No one has yet come forward with a study of how, after such association has been determined upon, the data should be combined to develop the premiums for the minor classifications. Yet if this is the only way to determine rates for these classifications, there must be some rule or method of procedure which will stand the test of scientific analysis and criticism. It was with a view to discovering such a method that the present study was undertaken, and it is in the hope that the result thereof may be subjected to such a test that it is now presented here.

FAULTS OF METHODS HERETOFORE USED.

It is well known to the members of this Society that last year when rates for compensation insurance in New York were being made, it was announced that they would be obtained by applying a multiplier of 3.24 (covering law differential and expense loading) to the pure premiums developed from Massachusetts experience and recorded in Schedule Z; but that when the published rates were divided by this factor and the basic pure premiums so found were

* See Rubinow, PROCEEDINGS, I, 10-23; Mowbray, *T. A. S. A.*, XV, 92-93; Ryan, *T. A. S. A.*, XV, 369; Whitney, *T. A. S. A.*, XVI, 215.

multiplied into the Schedule Z payrolls it was found that the "expected losses" so found exceeded the actual losses as shown in the schedule by approximately 23 per cent. Considerable publicity was given the matter at the outset, but later, on the statement of the Insurance Department that there was no chicanery involved, the matter was allowed to drop without further press comment. Aside, however, from the statement that Massachusetts experience was not strictly followed, that personal judgment of experienced underwriters aided by data from other sources was also used and that the difficulty presented by scanty data was bridged by grouping analogous hazards, no clear explanation was furnished why this loading of the pure premium occurred, although it was stated it was not unexpected.

It is generally understood that these rates were made by a conference of the best underwriters looking upon the general questions involved from more or less divergent viewpoints and the product was the result of a study of the data in the light of thorough discussion among them. As I understand it, they considered the classifications and associated those in which the hazard was thought so far analogous as to justify it. Premiums for the group were then fixed largely on the basis of the experience of the most prominent classifications though modified by personal judgment for some classifications and the assumption of minimum premiums in certain cases. Such a process carried out by conservative men may be expected to produce results which will deviate more or less from the fundamental data and, fortunately, generally on the safe side as in the case in question.

It would seem, however, that much experience data was, to all intents and purposes, thrown away at least as far as direct use for determination of rates is concerned, because it dealt with a large number of classifications with so small an exposure upon each that it apparently was considered unavailable. Even at best our experience data for many years will be all too scanty and to further restrict it by absolutely discarding a considerable part seems unjustifiably wasteful if a method can be found to utilize it. Addition of data where the hazard is considered to be the same may utilize some of it, yet even with this help we lose much unless we can find some more scientific way of working over our material.

PERSONAL JUDGMENT MUST BE USED TO SUPPLEMENT
STATISTICAL DATA.

If the writer's conclusions as to mathematical risk* are sound and the limitations therein set forth must be further restricted for other considerations such as the number, size and character of establishments entering into the experience, it is evident that so long as the manual in use follows present lines there must always be many classifications upon which the experience will be so limited that equitable rates cannot possibly be made from classification experience. Yet, if we are not to discriminate in favor of one industry by transferring too large a part of its accident cost, or against another by placing upon it a burden it should not bear, we must discriminate in rates according to hazard so that, subject to the disturbing influence of accidental variation, each classification shall stand substantially on its feet. We cannot do this without making use of able personal judgment.

The problem before the profession in attempting to formulate a plan of scientific rate making (and for one, I believe that if we are to create and maintain confidence in our profession and its work we must before long place before the public something which will appeal to them as more scientific than methods heretofore in vogue) is to combine personal judgment and experience data in such a way as to use all the light available and produce results which can be predicted in advance with a considerable degree of accuracy, and further, can be tested and checked up as the work progresses.

WHEN PERSONAL JUDGMENT IS AT ITS BEST—GROUPING OF
CLASSIFICATIONS.

No matter what the field in which personal judgment is to be exercised, it is axiomatic that if that judgment is to be quantitative in character and not merely qualitative it will be much more accurate if confined to discrimination between the elements of a relatively small and homogeneous group than when like discrimination must be made between individuals in a large heterogeneous group. For example, we will form much more accurate judgment of the relative heights of a group of men than of the relative heights of a group of an equal number of objects composed of trees, buildings, men, animals, etc. And again even within a homogeneous group,

* PROCEEDINGS, I, 24-30.

judgment of relative values will be more accurate than judgment of absolute values. We will then probably gain, if the exercise of personal judgment is along these lines. This presumes a grouping of manual classifications according to nature of hazard, and where there is a wide variation in degree with further subdivision into sections according to degree.

Grouping of classifications has been the subject of considerable discussion recently and there seem to be two rather divergent lines of approach. The State Industrial Commissions accustomed to census grouping by products are inclined to follow that precedent, and in this they are encouraged by the phraseology of our manual classifications, which are generally expressed in terms of product. Of course, from an actuarial point of view the only grouping which is of value is a grouping according to hazard, and if the data are to be combined without modification only those classifications should be associated which are alike in both kind and degree of hazard within pretty narrow limits. It is proposed, however, to modify the data so as to justify its use in combination when the hazard is alike in kind, but varies in degree.

THEORY UNDERLYING PROPOSED METHOD.

It is an old mathematical trick in attempting the solution of a problem to assume that it has been solved and study the relations between the several elements from which very often a method will be developed which will furnish a ready solution of the problem. This method may be advantageously applied to the matter in hand.

If it be assumed that there is available a large volume of data on a group of, say ten, kindred classifications such that for each the exposure is in all respects sufficient to give a thoroughly dependable pure premium, then obviously we can express the hazard of each as a percentage of one taken as the standard of reference. If then, we take the reciprocal of each of these percentages and multiply the losses in each classification by it we will obtain a hypothetical loss figure which, when divided by the payroll, will give a pure premium equal to that for the base classification. Of course, the addition of the payrolls and hypothetical losses will give aggregate figures from which the same pure premium would be derived. Multiplication of this pure premium by the percentages expressing the relation of the several classifications to the base will again, obviously, reproduce the original pure premiums.

Let it now be assumed that this data has been lost and that only the percentages remain, but that we know the percentages are accurate and were derived from a dependable experience. In place of the large volume of data for the group we may now have only a small exposure on each classification, though the aggregate exposure if on one classification would be sufficient to furnish a dependable pure premium. Even though the pure premiums in such limited data bore very different relations to each other from the percentages derived from the large experience, it would seem we would be amply justified in assuming that this difference was entirely accidental and that if we multiplied actual losses by the reciprocals of our percentages and added the results, dividing them by the aggregate payroll, we would have a true base pure premium from which the classification pure premiums could be found by multiplying by the percentages known to be based upon ample experience. Under certain circumstances, which could be suggested, this process might somewhat distort results, but it is believed that these circumstances under which serious distortion would occur are very unusual.*

STATEMENT OF PROPOSED METHOD.

Of course, in actual practice, we will never have a series of percentages derived from dependably large, statistical observation of payroll exposure, and then be compelled to determine pure premiums from limited data because the more extensive data is lost. But it would seem that if we can find the percentages from any source, for example, from personal judgment, which we regard as dependable that the process may still be used.

This, then, is the proposed method. Let the relative hazards within a group be determined by the kind of personal judgment hereinafter referred to and expressed as percentages of a given classification. Let the losses on the several classifications be multiplied by the reciprocals of these values, and the sum of the products be taken and be divided by the sum of the payroll exposures. Let the pure premiums thus produced be multiplied by the judgment percentages and the results taken as the classification pure premiums, subject to test by comparing the expected losses for the group produced by their use with the actual losses, and subject to such further adjustment as this test shows to be necessary.*

* See appended note.

The method seems to have the following advantages:

1. It combines personal judgment and statistical data according to a scientifically developed theory.
2. It uses every bit of usable data and does not distort the result by allowing only a part of it to have influence upon the final result.
3. It produces results which are subject to check at intervals throughout the work.
4. It keeps competitive and commercial aspects of the problems in the background during this part of the work, and this makes for calmer and fairer judgment.
5. It calls for the use of judgment under such circumstances as to make it most accurate and dependable.

The only requirement the theory makes as to the determination of the percentage relationship within the group is that it shall be so fixed that its accuracy may be considered as dependable as though such determination rested upon the most acceptable statistical basis. Apparently simple, this requirement is, however, most exacting, but not more so, nor indeed as much so, as the methods heretofore in use if best results are to be obtained. It is the writer's personal view that when the problem is restricted, as here, to discriminate between degree of hazard among the members of relatively small groups where the hazard is of essentially like quality, best results will be obtained if this work is first done by high grade engineers and then subjected to the criticism of competent underwriters. I believe the application of engineering judgment to the problem in this form is of fundamental importance.

WHY ENGINEERING JUDGMENT PREFERRED.

As it has been heretofore considered that rate-making is the function of the underwriter primarily, with such assistance as the actuary may render, there should probably be some explanation furnished of the proposal to transfer the most important part of this work to the engineering department which it has been considered should have little if any part in rate-making. This explanation is to be found in a study of the work performed in the three departments and the way in which this work tends to qualify those performing it for exercising this judgment.

The function of the actuarial department is the recording of payrolls and losses by classifications so as to form experience tables,

and the making of computations of rates and reserves from such tables. Usually this department also compiles any other statistics the office may require. Clearly, this work does not qualify for the exercise of the type of judgment here required since the actuary can only work from the statistics before him, and in the absence of adequate statistics he has no basis of judgment.

The service the underwriter performs for his company is the selection of business so as to secure a satisfactory profit for his stockholders, or margin of dividends for his policyholders if his company be a mutual company. This calls for the exercise of judgment in discriminating between risks in the same class, having regard to the promulgated rate for that class. The underwriter, therefore, is constantly studying statistics of experience with individual risks in order to determine which of a given group will probably give a favorable loss ratio for his company and which should be rejected because the loss ratio will probably be unfavorable. The statistical data with which he works are not primarily group data of payrolls and losses, but individual loss ratios compared with general loss ratios. If, due to the intrusion of a few bad risks the experience of his company with a given classification has proven unfavorable over a term, he obtains the impression that this business is poor business and should be discriminated against, and on the other hand, if certain lines of business prove especially profitable to his company, this seems to him good business and in rate-making he will be disposed to give it a low rate. It may be that his favorable experience has been due entirely to unusual skill of his own or his agency organization in securing desirable business, or to his engineering department's work in improving the character of the particular examples of this type of business which comes to him. His judgment throughout is formed by impressions of financial transactions with all the elements of luck and skill which enter into them. His attention is concentrated on the abnormal (good or bad) not the normal or average.

The duty of the safety engineer (and by this is meant a distinctly different type of man from the viewpoint of education and experience than a mere safety inspector) is to prevent accidents where possible, and where it is not possible to prevent them to minimize the seriousness of their consequences. To do this efficiently in any industry he must know the types of machinery used in that industry and their inherent hazards, the processes carried

on, the raw material used, chemical combinations involved, etc., and the average as well as the superior and under-average conditions of operating practice. In order that he may not recommend the expenditure of money on improvements which will not give a commensurate return, he must know the relative exposure to each type of hazard.

The theory of classification rate-making, as the writer understands it, is that the hazard determines the loss so that when a satisfactory individual rating schedule has been developed for distinguishing between individual risks, those having the same hazard in kind and degree may take the same classification rate. If this is the principle which the making of classification rates is presumed to follow, then it would seem that because of his knowledge of inherent hazard the engineer is primarily the one best qualified to exercise the kind of judgment called for in this process, to accurately distinguish relative hazard of average risks in similar but not equally hazardous lines of industry.

Of course, when the percentages have been fixed for the several groups the remainder of the process becomes largely mechanical and under proper supervision can be performed by ordinarily competent clerks, although if when the test proposed is applied to any group it indicates that further adjustment is necessary, men of high ability will be required on the problem.

The method herein presented has been brought to the attention of the Manual Committee of the Massachusetts Inspection and Rating Bureau and although not formally adopted by them, it has been considered of sufficient value that the Engineering Committee (Safety and Inspection Committee) of that Bureau has been requested to undertake the first problem, viz., of ascertaining the relative percentages within the several groups. It is not unlikely that the method will at least be tested in the construction of the new Massachusetts Manual and that at some subsequent meeting of the Society it will be possible to present the results of that test of practical application.

NOTE

Since this paper was written, but before its presentation to the Society, the method described was presented for consideration of the Pure Premiums Committee of the Joint Conference on Workmen's Compensation Rates. During a discussion of it there, a

slight change in mode of operation was suggested by Dr. Rubinow, which makes it reproduce, in the projected loss, the actual losses with a fidelity limited only by the number of places to which the computation of pure premiums is carried.

Dr. Rubinow proposes that instead of multiplying the losses by the reciprocals of the judgment percentages, adding the results and dividing by the sum of the pay rolls to produce the pure premium for the classification rated as unity, we multiply the pay rolls themselves by the judgment percentage and use the sum of the products for a divisor against the actual losses for the group.

The theory underlying this procedure corresponding to the explanation given above of the method first proposed is as follows:

If any classification has a hazard value equal to X per cent. of the classification chosen as the standard of reference then, the same factors of chance variation being present, the recorded losses would have been produced by a pay-roll exposure on the standard classification only X per cent. as large.

The reason why Dr. Rubinow's modification of the formula gives more accurate results than the formula as first presented is that the latter operates on the numerator of the fraction L/P , which is subject to large chance fluctuations from its true value. Hence the chance fluctuations to be distributed over the group are magnified or reduced according as they occur in classifications less or more hazardous than the average of the group. The denominator which is operated on under the modified formula is the constant term for the purpose for which it is used. Hence there is no change in the amount to be distributed.

The following hypothetical group worked out by both methods will illustrate the process and the difference between the two methods:

ORIGINAL FORMULA.

Classification.	Judgment Rating.	Reciprocal.	Observed Losses.	Mod. to Stand. Basis.	Pay Roll.	Pure Prem.		Projected Losses
						Original Experience.	Adj. by Formula.	
A...	.50	2.00	\$ 2,500	\$ 5,000	\$ 500,000	.50	.064	\$ 320
B...	.75	1.33	1,000	1,333	1,000,000	.10	.096	960
C...	1.00	1.00	100,000	100,000	80,000,000	.125	.127 +	101,600
D...	1.25	.80	5,000	4,000	5,000,000	.10	.158	7,900
			\$108,250	\$110,333	\$86,500,000	.125	.127 +	\$110,780

Excess Projected over Actual Losses approx. 2 per cent.

MODIFIED FORMULA.

Classification.	Judgment Rating.	Observed Pay Roll.	Corresp. P. R. Standard Basis.	Observed Losses.	Pure Prem.		Projected Losses.
					Original Experience.	Adj. by Formula.	
A.....	.50	\$ 500,000	\$ 250,000	\$ 2,500	.50	.062	\$ 310
B.....	.75	1,000,000	750,000	1,000	.10	.093	930
C.....	1.00	80,000,000	80,000,000	100,000	.125	.124	99,200
D.....	1.25	5,000,000	6,250,000	5,000	.10	.155	7,750
		\$86,500,000	\$87,250,000	\$103,250	.125	.124	\$108,190

Deficiency Projected under Actual Losses approx. $\frac{6}{100}$ per cent.

LIABILITY AND WORKMEN'S COMPENSATION LOSS RESERVES.

BY

ROBERT K. ORR.

The laws of the various states, relating to liability and workmen's compensation insurance, are crude in the extreme when viewed from a logical and scientific viewpoint. Even more crude are the plans advanced by some of our able actuaries. What we lack more than anything else is a standard, legalized, accident table by which we can measure the expected cost and determine the proper reserves regardless of the premiums collected.

It is almost an axiom that inadequate premiums will, under our present laws, produce inadequate reserves, this, of course, being due to the fact that the reserves are computed as a percentage of the premium.

It is possible under our present laws and methods of computation, for a company to be hopelessly insolvent, yet legally in good financial condition. It reminds one very much of the old fraternal laws, under which a fraternal was solvent, even when it was six months or more behind in the payment of losses.

It would seem to be high time for the various states to wake up to the fact that our reserve laws are inadequate and need immediate attention, otherwise we will certainly have some insolvent companies and some unpaid compensation claims. I can think of no greater calamity to stock insurance in general than the failure of some injured workingman to get his compensation. Such a situation is possible when we have the combination of an irresponsible employer and an insolvent insurance company with non-assessable stock.

An examination of the convention blank of the National Convention of Insurance Commissioners, is very interesting in this connection. I have in mind the following situation:

The earned premium for the year 1914 in this case contained over 50 per cent. of not-taken premiums, a similar situation obtained in the years 1910, 1911, 1912 and 1913. This will account for the

SCHEDULE "P"—SCHEDULE OF EXPERIENCE.

Year in Which Policies Were Issued.	Amount of Earned Premiums.	Amount of Loss Payments Including Loss Expenses.	Suits Pending Dec. 31 of Year of Statement Except Suits Not Dependent on Negligence.		Unpaid Death Claims Dec. 31 of Year of Statement, Without Proof of Negligence.		Unpaid Claims (Non-fatal) Dec. 31 of Year of Statement Without Proof of Negligence.		Sum of Items in Columns 2-3b-4b and 5b.	Loss Ratio Col. 6a Divided by Col. 1.
			No.	Amount Charged Against Suits at \$750.00 Each.	No.	Amount Necessary to Pay for Each Death.	No.	Present Value of Estimated Future Payments.		
(1)	(2)	(3a)	(3b)	(4a)	(4b)	(5a)	(5b)	(6a)	(6b)	
1st period:										
1905.....										
1906.....										
1907.....										
1908.....										
1909.....										
1st total										
2d period:										
1910.....	\$ 40,000	\$ 50,000							\$ 50,000	1.25
1911.....	110,000	130,000	3	\$ 2,250					132,250	1.20
1912.....	150,000	150,000	3	2,250	1	\$1,200			153,450	1.02
1913.....	160,000	180,000	20	15,000	1	2,000	10	\$4,000	211,000	1.32
1914.....	290,000	100,000	10	7,500	1	2,000	12	5,000	114,500	.39
Total...	\$750,000	\$610,000	36	\$27,000	3	\$5,200	22	\$9,000	\$661,200	

loss ratio in 1914 being so much lower than the ratios for prior years. When the year 1914 is straightened out and not-taken business is charged off, the ratio will be around 100.

Let us now turn to the matter of loss reserves. In the second part of Schedule "P" we find this interesting situation.

Years in Which Policies Were Issued.	53 % of Earned Premiums Stated in Col. (1), 2d Period.	Deduct Loss Payments and Expenses Stated in Col. (2), 2d Period.	Remainder.	Sum of Amounts Stated in Columns 3b-4b and 5b for Each Year of 2d Period.	Carry out for Years 1910-1911 1912, the Amount Stated in Col. C or D Whichever is Greater and for the Years 1913 and 1914, the Amount Stated in Col. C.
	(A)	(B)	(C)	(D)	(E)
1910.....	\$21,200	\$50,000	-\$28,800	—	—
1911.....	58,300	130,000	— 71,700	\$2,250	\$2,250
1912.....	79,500	150,000	— 70,500	3,450	3,450
1913.....	84,800	180,000	— 95,200	21,000	—
1914.....	153,700	100,000	53,700	14,500	53,700
Total...	\$397,500	\$610,000	\$53,700	\$41,200	\$59,400

In the first place it will be noticed that the losses shown in Col. (B) greatly exceed the 53 per cent. of earned premiums shown in Col. (A) for the years 1910, 1911, 1912 and 1913. The year 1914 will show the same situation as soon as the not-taken premiums are charged off. This of course shows that the company is being operated at a heavy loss. The absurdity of this system however is most thoroughly shown in the year 1913 wherein the loss payments exceeded the 53 per cent. of the earned premiums by \$95,206. with outstanding losses of \$21,000 but with no reserve required by the blank. It will also be noticed that under the working of this blank the higher the loss ratio the lower will be the reserves.

No sane person can successfully contend that this system of computing reserves is correct. It may produce adequate reserves for companies operating under adequate premiums, but what about the company that is charging inadequate premiums? Under this system the very company that needs the closest watching and should be compelled to carry heavy reserves is allowed to become hopelessly insolvent and yet show legal solvency.

The remedy for workmen's compensation business is the adoption of a standard accident table by the state. We have a mortality table for life insurance business, why not an accident table for workmen's compensation? There is now sufficient experience from which to derive such a table and although the same might not be perfect by any means, yet, the business could be placed on a sound basis and injured workmen would be sure of receiving their compensation in full.

While it may be true that it will be difficult to apply a standard table to liability business, yet, there is no reason why state officials should stand idly by and make no effort to change our laws so as to, at least, compel a company to carry a reserve for outstanding liabilities. As far as liability business is concerned, the great danger is with the young company having inexperienced underwriters and actuaries. It should not be a difficult matter to have our laws changed so as to compel all companies to carry adequate reserves as shown by reliable experience, such reserves to be independent of the premiums collected by the companies.

It is also merely the statement of a self-evident fact that unearned premium reserves based upon inadequate premiums will also be inadequate. This reserve should also be computed independently of the premiums collected, but with proper allowance for acquisition

cost. Otherwise, the companies should be compelled to collect adequate premiums.

It has been suggested that any legislative action should be along the line of compelling all companies to charge adequate premiums. As far as solvency is concerned, any such action would be futile unless it extended to every state in which a company operated and I am wondering how far New York could go in controlling rates charged in Michigan. There is no doubt, however, that the various states can regulate reserves and can exclude a company that does not carry reserves as required by the law of the state, neither should it be a difficult matter to have the laws changed so as to require adequate reserves. Serious opposition is to be anticipated, however, to any movement to regulate rates and to make the application extra-territorial. The American people, as we all know, are opposed to any action which will foster monopolies, and the regulation of rates would seem to many people to do this very thing.

Summing up the whole situation, it would hardly seem necessary, in view of the self-evident inadequacy of our reserve law, to be obliged to urge a change. Nevertheless, it may be necessary to have a few failures, to have a few workmen or widows fail to get their compensation, in order that the states may realize the gravity of the situation. It should be borne in mind that employer's liability insurance is becoming a thing of the past and in a few years will not be a matter for serious consideration. Our present efforts should, therefore, be directed to the matter of adequate reserves for workmen's compensation.

REVIEWS OF BOOKS AND PUBLICATIONS.

Report of the New York State Workmen's Compensation Commission from July 1, 1914 to Dec. 31, 1914. Albany, 1915. 151 pages.

To students of social insurance this report is distinctly disappointing. It covers only six months' experience under the New York Act, and it covers that period inadequately. A general description of the Commission's work occupies about 30 pages. Some 25 pages are given over to an itemized list of expenditures—material, which to say the least, is of no general or permanent interest. The activities and advantages of the State Insurance Fund are recited at some length. Of accident statistics, there are none. There is not even a clear statement of the manner in which the 130,000 accident notices received by the Commission were disposed of nor is material presented for an intelligent judgment of the merits of payment through the Commission as contrasted with direct settlements.

The report of the State Insurance Fund presents the record of a successful half-year. Whatever may be said on controverted points, an insurance carrier which enrolled 7,000 policyholders and wrote over \$1,200,000 annual premiums during the first six months of its existence, and that in the face of active competition, must have been efficiently managed and have commanded a fair share of public confidence.

The one thoroughly satisfactory portion of the report was contributed by the actuarial department. The actuaries of the Commission were called upon to solve problems distinctly novel in this country and of great intrinsic difficulty. The able manner in which they met their task is familiar to all members of this Society. Fortunately the substance of the actuarial material here presented has already been published in the *Proceedings*, so that no extended comment is called for in this place.

The concomitant failing of the present document is the total want of accident statistics. The public rightly look to the administrators of compensation laws for authentic information about work accidents, their causes, their physical and economic effects, and the extent to which the resultant wage loss is indemnified. The ad-

ministrators alone have access to the whole experience under each law. No expenditure of time or money by private insurance carriers can give anything like so complete a picture. Many problems of grave social as well as technical importance—an adequate scale of benefits, proper medical attendance, efficient administration of the laws, no less than adequate insurance reserves and equitable insurance rates—depend in a large degree, upon comprehensive, accurate and intelligible accident statistics. The obligation of the New York Commission is all the greater because they administer the most advanced of American compensation laws in the largest industrial community on this continent. It is devoutly to be hoped, therefore, that the present Commission will permit their very competent statistician adequately to fulfill his public functions.

E. H. DOWNEY.

Industrial Health-Hazards and Occupational Diseases in Ohio. By E. R. Hayhurst, A.M., M.D., Director, Division of Occupational Diseases, Ohio State Board of Health. Issued by the Board, Feb., 1915. xviii + 438 pages.

“In Ohio in the year 1913, there were 68,378 deaths. Over half of these would not bear scrutiny as either timely or justifiable.” Deaths from preventable causes (of which six-sevenths are diseases) are 43 per cent. of all deaths in 131 trades and callings. “From one-fourth to one-third of the medical afflictions of tradespersons are due in whole, or in great part, to industrial health-hazards.” No doubt these ratios with little variation would apply as well anywhere from Maine to California. That they are startling only emphasizes past neglect and bears witness to the timeliness of the present painstaking contribution.

“Occupational diseases are exceedingly common. They are, however, *primary diseases*, and only little attention is paid to their symptoms when they are calling loudest for recognition and at a time when they are easy to cure and control. On the other hand deaths directly due to them are among the rarest of happenings, this because *degenerative diseases*, which are secondary (of the heart, kidneys, lungs, etc.), prove to be the terminal afflictions.” “Specific occupational diseases, such as lead poisoning, are recognized in more than one out of three or four instances, more especially the chronic cases.” Yet “the health-hazards of industry which cannot be feasibly removed are insignificant in number.”

The present investigation was instituted by the Ohio State Board of Health and authorized by legislative enactment for the purpose of determining the underlying causes that contribute to the "unnecessary sickness and shortening of life." It is not the first work in this field in Ohio, but follows the well-established trail blazed nearly thirty years ago by the Board in standard educational and suggestive articles on industrial health and sanitation. The report deals principally with the industrial hygiene of work places, and does not purport to present complete lists or citations of occupational diseases. As a rule, it indicates the numerical extent of the field in which specified numbers of cases in point are discovered. It rarely furnishes the means of determining the *annual* sickness rates, however, with which the actuary or statistician is of necessity most often concerned.

In the investigation, Director Hayhurst had the active assistance of a number of prominent Ohio physicians and hygienists. The examination was devoted principally to factories and factory processes, and in all cases the figures refer strictly to wage-earners. To make the survey representative and fair, plants of various sizes and locations in each industry were investigated, employing about half the wage-earners in the state. The investigators always came unannounced. Managements rarely failed to do everything in their power to enable them to get at the facts. "While a lack of technical knowledge upon the part of the physician-investigator interfered more or less with his ability to describe processes, it did not interfere with his ability to observe the presence or absence of the ten or twelve health-hazards for which he was seeking in each place, and to report upon the same according to the blank forms [shown in the report] and the instructions under which he worked. . . . In summarizing, the rule has been followed to give the benefit of the doubt to the figures representing the better conditions."

Industrial health-hazards as they concern the industries of Ohio, are dust, dirt, dampness, darkness, devitalized air, temperature, fatigue, inactivity, infections, poisons, and as an aftermath, or because of the absence of good drinking water, industrial stimulantism by alcohol, coffee, or drugs. An industrial health-hazard is defined as "any condition or manner of working that is unnatural to the physiology of the human being so engaged." A "most important feature in the relationship between work and disease is the problem of the worker himself. Some workers are very much more suscep-

tible to the health-hazards mentioned above than are others, so much so that as hygienic as certain industries and processes can possibly be made, still there are certain classes of persons who should not engage in them. This is exemplified today, in many instances, as a matter of natural selection; for instance, the more delicate and sickly disposed persons, "at least at the younger ages, do not follow the more fatiguing or heat-exposing trades."

The need felt by the investigators for standards of measurement of amount of dust, illumination, devitalizing air, etc., is given expression in the statement that "the next logical step in the field of industrial hygiene and occupational diseases is the establishing of these standards and their adoption by a proper body having recognized authority." Insurers in this field, contemplating the possible requirement sooner or later of premium gradation by merit rating according to individual conditions, will heartily concur in the suggestion. Another difficulty, experienced in the determination and classification of occupations, leads the author to recommend the introduction of the term "industry-department-process" in place of the word "occupation" for more definite designation of the duties of workers.

After a chapter summarizing available vital statistics and recommending authoritative works of reference, and a chapter defining the principles of industrial hygiene by which the survey was guided, a general description is given in Part IV of the investigation, and the extent of it, by industries divided into six classes: those using poisons as a chief hazard, dusty industries, those in which fatigue and inactivity are the chief hazards, those in which there is a more than usual liability to contracting communicable diseases, and industries having miscellaneous hazards not above included. Specimen records, one by a rubber company and another by a large steel company, form a valuable addition to the chapter, which closes with a recapitulation of the industries investigated. Description of trade processes is then taken up at length in the principal chapter, Part V, devoted to determination of the hygienic status of the health-hazardous trades. The amount of information condensed into this part is but poorly measured by the two hundred fifty pages of the report devoted to it.

Authentic cases of occupational diseases are then summed up and classified in Part VI. The tables of cases by industries and processes, with which the chapter closes, include the 1,204 "positive

cases," that is, those in which the specific symptoms and signs were present as well as the specific health-hazard on hazards, and the 211 "tentative cases" in which disability was present but without enough specific symptoms or signs for positive diagnosis, although the hazards were present. They do not include "past cases" in which the specific symptoms or signs were present prior to 1913—the survey began in the middle of 1913 and continued sixteen months—nor "hearsay cases" in which information that could be regarded as authentic was at hand together with the actual evidence of the hazards. The author therefore considers the tables very conservative. In an added column he presents symbolically his personal estimates of what may be called the incidence of industrial disease in each trade process.

Following a chapter of special investigations, the report closes with several suggestive pages on measures of prevention.

The book is well indexed and has been prepared in such form that the wide circulation it merits, need not be unduly restricted by expense. Illustrations to the number of about a hundred here and there effectively visualize the points in the text.

JAMES D. MADDRILL.

Massachusetts Industrial Accident Board, Boston, Bulletin No. 13, October, 1915.

This is a sequel and supplement of Bulletin No. 9, urging manufacturers to form safety organizations and offering to co-operate to this end. The present bulletin gives the results of the Board's study of the effect of the safety work done by forty-eight establishments having a total of 56,587 employees. From this study, the Board concludes that safety work has produced a reduction of 41.1 per cent. in the compensation cost.

While it is generally recognized that thoroughgoing safety work is very effective in reducing accident cost, this result is so much in excess of the showing made for the first year by some of our large corporations which have been most active in safety work, that one suspects some fault in the compilation of the figures upon which this conclusion is based. These are the accidents occurring in the two periods July 1 to December 31, 1913, and July 1 to December 31, 1914, studied as to number, time loss involved, compensation cost, etc. These returns are probably accurate and the 41.1 per cent. is the difference in compensation payments; that for the

first period having been \$9,035 and for the second \$5,329. It may be remarked in passing that these figures are too small to avoid the conclusion that mere chance in the incidence of claim cost may in considerable measure be responsible for this showing.

But it is also to be noted that the comparison is between the absolute amounts paid in the two periods and not the amounts per \$100 of payroll exposure. It seems to have been assumed that the exposure during the two periods was the same. This may have been the fact, but when it is remembered that the second period was the six months immediately following the outbreak of the war, a period of readjustment, retrenchment and slowing down of industry, it seems hardly likely. It would rather seem that the accidents of the second period should be related to a much smaller payroll and this too probably representing operations conducted under less pressure and stress.

Even had the comparison been made upon this basis, it is probable that with sufficient exposure to eliminate the effect of accidental variation a very creditable showing would have been made. Excessive claims for the results of safety work based upon loosely compiled statistics may react to check this beneficial movement.

ALBERT H. MOWBRAY.

The Mathematical Theory of Probabilities and Its Application to Frequency Curves and Statistical Methods. By Arne Fisher, F.S.S. New York: Macmillan, 1915. xx + 171 pages, octavo. Volume 1. Mathematical Probabilities and Homograde Statistics.

In an introductory note by Mr. F. W. Frankland, F.I.A., F.A.S., F.S.S., Examiner in Statistical Method and in Pure Mathematics to the Government of New Zealand states: "It is hardly necessary to point out what a very large amount of new ground is covered by Mr. Fisher's new book. The scientific world is to be congratulated on Mr. Fisher's presentment of a new and sound point of view, and he emphatically is to be congratulated on the production of a text-book which for many years to come will be invaluable both to students and to his confreres who are engaged in extending the boundaries of this fascinating science."

Mr. Fisher treats his subject not only from the mathematical but also from the philosophical standpoint, and in the early part of his work contrasts the principles of "insufficient reason" and "cogent

reason" in connection with equally likely cases. The book by no means consists of purely abstract mathematical theory, formula, and solution. It abounds with concrete problems, many of which are prefaced by the history of their propounding, such as the question asked of Galileo by an Italian gambler as to why in throws of three dice, the sum of ten appeared more frequently than the sum of nine.

An interesting chapter is devoted to the history of probabilities; and the writer throughout his book, by reason of his familiarity with the languages in which foreign works on his subject have been written, brings to his readers a wealth of information given to the English reading student for the first time in his native tongue. In connection herewith may be mentioned the Theorem of Tchebycheff, the eminent Russian mathematician, concerning probabilities in connection with the absolute value of mean errors; and the chapter on "The Theory of Dispersion and the Criteria of Lexis and Charlier" which consideration hitherto in English has been confined to mathematical papers only.

The student's interest is intensified by historical sign-posts being attached to the problems treated. The famous problems are given a local habitation and a name. As the law-student has his "Rule in Shelly's Case" and his "Maxims in Equity" in similar manner does Mr. Fisher show us a necklace of the gems of his subject: De Moivre's Problem; Tchebycheff's Problem; The Petrograd Problem; Baye's Rule; Stirling's Formula; Bing's Paradox; Wallis's Expression of π as an Infinite Product; the Experiments of Westergaard, Charlier, Bonyngé, and Fisher and others.

The Law of Large Numbers is well treated in a number of chapters devoted thereto, which lead up to the writer's consideration of the Theory of Dispersion, to which the studies of Charlier, Poisson, Bernoulli, Westergaard, Bonyngé, Fisher, and Lexis are made to contribute. The last two chapters are devoted to the application of the theory of probabilities to games of chance and statistical problems in which known statistical data, such as child-births in Sweden and in Denmark, marriages in Denmark, coal mine fatalities in various countries and mortality from cancer throughout the world are shown and used as illustrations for the determination of Lexian ratios of dispersion and the Charlier coefficients thereof.

Mr. Fisher's book can be read with interest by any student who

has the algebraic knowledge necessary for admission to a standard college, and at the same time his new presentation of this subject in which the learning of Europe is placed within reach of those who read English only will fascinate those who have read the English treatises. The collection in one book of the studies of many mathematicians and philosophers will be a valuable addition to the library of any actuary or statistician.

It is with pleasure that we learn that the second volume, though not in print, exists to-day in manuscript form, and those who read the first volume now published will look forward to receiving the second one.

C. E. SCATTERGOOD

CURRENT NOTES.

The Department of Health of the City of New York has recently established within the Bureau of Records a Division of Statistical Research. The need of such a division had long been felt and its creation contemplated but the necessary funds were not available. The president of the Board of Health, Dr. S. S. Goldwater, feeling that even an embryo statistical division would be better than none, created a new division by detailing clerks from other bureaus. It is hoped that the new division, even with so small a nucleus will be able to justify its existence and in that way secure in the next budget the financial aid necessary for its further development. S. W. Wynne, M.D., assistant registrar, Manhattan, has been designated chief of the division and will be responsible to William H. Guilfooy, M.D., registrar of the Department.

The new division intends widening the scope of the present statistics published by the Department, to popularize them by use of simple descriptive charts and graphs that will be intelligible and interesting to the public. The division further hopes to take over the preparation of the statistics of the other bureaus of the Department, to standardize and develop them as the needs of the bureaus may suggest. Particular attention will be paid to the development of industrial morbidity and mortality statistics and those city departments employing medical examiners as, for example, the Police and Fire Departments, will be asked to send the Health Department their sickness reports for tabulation and analysis. Large industrial corporations maintaining medical bureaus will be invited to co-operate.

Industrial statistics are practically virgin territory and the field opened up presents abundant practical possibilities not the least of which is that the data secured will form the foundation for sickness insurance in the future. The statistical side of child hygiene has been neglected and the new division contemplates making practical use of this store of valuable data now going to waste.

A census of illness has just been taken in the experimental Health District by the new division, the results of which will be published shortly.

The new division will be glad to co-operate with those interested in statistics, to participate in conferences and receive helpful suggestions.

The October, 1915, Bulletin of the New York City Police Department contains an interesting series of tables on street accidents in New York City for the summer months of June, July and August of 1915. The material also presents cumulative tables for the earlier months of 1915 showing the number of persons killed and injured in street accidents, further classified to show the number and proportion of children under sixteen years of age. Other tables in the report show the kinds of vehicles and the nature of the violence responsible for the accidents and injuries. The hour at which accidents occurred and the degree of injury are dealt with in Tables 6 and 7.

Mr. Mills E. Case prepared the analytical text and directed the statistical analysis of the data.

The Department has recently greatly improved its facilities for compiling accident statistics and has introduced a revised report form which it is hoped will lead to the further improvement of the data.

RECENT LITERATURE
ON
CASUALTY AND SOCIAL INSURANCE.

PREPARED BY

S. LEON LEVY

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A. CASUALTY INSURANCE.

1. *Accident and Health Insurance.*

CRAIG, J. D.

Health Insurance from a Theoretical and Practical Aspect.
(Transactions, Actuarial Society of America, Vol. XV, Part
2, No. 52, October, 1914, pp. 271-290.)

FULD.

Einwirkung des Kriegs auf die Unfallversicherung. (Zeit-
schrift f. d. ges. Versicherungswissenschaft, July, 1915, pp.
11.)

Contracts of accident insurance usually contain the clause exclud-
ing accidents caused by military events.

INSURANCE INSTITUTE OF HARTFORD.

Accident and Health Insurance. (A Series of Lectures delivered before the Insurance Institute of Hartford, 1915, pp. 155.)

WINSHIP, JOHN T.

Standard Benefits in Accident and Health Policies.—An address delivered at the meeting of the national convention of insurance commissioners, Monterey, Cal., Sept. 24, 1915. (Economic World, Sept. 25, 1915.)

2. *Burglary and Theft Insurance.*

QUINT, A. U.

- (a) Review of Burglary Insurance Conditions. (Econ. World, Sept. 18, 1915.)
- (b) Economic Value of Insurance against Loss by Burglary and Theft. (Economic World, Nov. 20, 1915.)

3. *Credit Insurance.*

TREAT, E. M.

- (a) Credit Insurance in Simplest Language. 1915, pp. 8.
- (b) Constructive Influence of Credit Insurance.—Address delivered before the World's Congress of Insurance, Panama-Pacific International Exposition, San Francisco, Cal., Oct. 5, 1915, pp. 8. (Both pamphlets are published by the American Credit Indemnity Co., St. Louis, Mo.)

VOSS, L. C.

Value and Importance of Credit Insurance. (Market World and Chronicle, April 10, 1915.)

4. *Fidelity and Surety Insurance.*

CATOR, BENJ. F.

Surety and Fidelity Insurance. (Econ. World, Aug. 21, 1915.)

MACKALL, LUTHER E.

The Principles of Surety Underwriting. 1914, pp. 348. (Baltimore, Md.: Thomas and Evans Printing Co., publishers.)

NATIONAL SURETY CO. OF NEW YORK.

Causes of Surety Bond Losses. (Spectator, Sept. 23, 1915, Supplement.)

5. *Strike Insurance.*

GERMANY.

Strike Insurance in Germany. (Monthly Review, U. S. Bureau of Labor Statistics, Vol. I, No. 4, Oct., 1915, pp. 77-85.)

SCANDINAVIAN COUNTRIES.

Strike Insurance in Scandinavian Countries. (Monthly Rev., U. S. Bur. Lab. Stat., Vol. I, No. 4, Oct., 1915, p. 86.)

For a bibliography on strike insurance in European countries see the same No. of the Monthly Review on page 77.

B. SOCIAL INSURANCE.

1. *Pensions and Relief Funds.*

AUSTRALIA—Dept. of the Treasury.

Invalid and Old Age Pensions. Statement for the 12 months ending June 30, 1915. Melbourne, 1915, pp. 10.

BAILWARD, W. A.

Naval and Military War Pensions Bill, 1915. (Charity Organization Review, Sept., 1915, pp. 11.)

BULLOCK, E. D. (Compiler).

Selected Articles on Mothers' Pensions. (White Plains, New York: Wilson, 1915, pp. 188.)

BURN, JOSEPH, and SYMMONS, FRANK PERCY.

Practical Points in Connection with the Formation and Valuation of Pension Funds, with a Note on Group Assurances. (Journal, Institute of Actuaries, Vol. XLIX, Part 3, No. 263, July, 1915, pp. 193-254.)

GREAT BRITAIN.

War Pensions in Great Britain. (Market World, April 10, 1915.)

KETTLEBOROUGH, CHARLES.

Administration of Mothers' Pension Laws. (American Political Science Review, August, 1915, pp. 555-558.)

MINNESOTA ACADEMY OF SOCIAL SCIENCES.

Papers and Proceedings: "Woman and the State." (Minneapolis, 1915, pp. 203.)

NEW YORK.

Report of the New York State Commission on Relief for Widowed Mothers. Transmitted to the Legislature March 27, 1914, pp. 584.

NEW YORK ASSOCIATION FOR IMPROVING THE CONDITION OF THE POOR.

Shall Widows Be Pensioned? (105 E. 22d St., N. Y., pp. 39.)

N. Y. CITY—Bureau of Municipal Investigation and Statistics.

Report relative to proposed legislation providing pensions to widows with children. 1915, pp. 26.

PARTHIER, H.

Das Äquivalenzprinzip in der sozialen Pensionsversicherung. Tables, formulae, and graphs for pensions in a system of social insurance. (Zeitschrift f. d. ges. Versicherungswissenschaft, March, 1915, pp. 52.)

PENNSYLVANIA—State Dependents Commission.

Report and Recommendations. 1915, pp. 88.

RIETZ, HENRY L.

Status of Certain Current Pension Funds. (The Record, American Institute of Actuaries, Vol. IV, Part I, No. 9, June, 1915, pp. 73-82.)

ROTH, LOUIS.

Pension Funds for Public Service Employes. (Survey, Oct. 30, 1915.)

TODD, ARTHUR J.

Old Age and the Industrial Scrap Heap. (Am. Statis. Association, June, 1915.)

WALKER, DWIGHT A.

Staff Pension Funds. (Transactions, Actuarial Society of America, May, 1915, Vol. XVI, Part 1, No. 53, pp. 109-144.)

WISCONSIN, INDUSTRIAL COMMISSION.

Report on Old Age Relief. (Madison, Wis., 1915, pp. 76.)

2. *Sickness Insurance.*

AMERICAN ASSOCIATION FOR LABOR LEGISLATION.

Health Insurance—Standards and Tentative Draft of an Act, Nov., 1915, pp. 26.

GAEBEL, K.

Die Neuen Ortssatzungen für die Krankenversicherung der Hausgewerbetreibenden. (Sozial Praxis, July, 1915, pp. 2.)

GERMANY—Imperial Statistical Office.

- (a) Vierteljahrsheft zur Statistik des Deutschen Reichs. 24 Jahrgang, 1915. Zweites Heft, mit 11 Tafeln, Berlin, 1915, pp. XI, 229.

This number constitutes the second issue for the year 1915 of the Quarterly Statistics of the German Empire, published by the Imperial Statistical Office. Besides the usual current statistical matter compiled by this Office, this particular number contains statistics of sickness insurance in the miners' relief funds for the year 1913, as provided for in Article 74 of the German Sickness Insurance Law (Insurance Code, 1911).

- (b) Sickness insurance and maternity benefits during the war, Notification of Jan. 28, 1915. (Reichsarbeitsblatt. Berlin, Feb., 1915.)
- (c) Sickness Insurance, 1911-1913; Social Hygiene: Care of the tuberculous by the National Insurance Institutes during the war. (Reichsarbeitsblatt, March, 1915.)

PROGRESSIVE NATIONAL SERVICE.

Sickness Insurance—Prepared for the Committee on Social and Industrial Justice of the Progressive National Service. (95 Madison Ave., New York, 1915, pp. 60.)

RUBINOW, I. M.

Standards of Sickness Insurance. (Journal of Political Economy, Vol. XXIII, pp. 221-51, 327-64, 437-64, March-May, 1915.)

STIER, SOMOLO F.

Die Krankenversicherung während des Krieges und das Ein-

greifen des Reiches in Friedenszeiten. (Zeitschrift. f. d. ges. Versicherungswissenschaft, March, 1915, pp. 26.)

WARREN, B. S.

Sickness Insurance, Its Relation to Public Health and the Common Welfare. (Pub. Health Reports, Reprint No. 250, Washington, Jan. 8, 1915, pp. 14.)

3. *Workmen's Compensation.*

AMERINE, W. M.

Fallacies of the Merit Rating System. (Market World, April 24, 1915.)

AUSTRIA.

New annuity valuation tables for Austrian Workmen's Compensation Insurance. (Market World and Chronicle, May 1, 1915. Translated from "Der National Oekonom," Vienna.)

BINCKLEY, A. W.

Medical Aid under the Workmen's Compensation Act. (Bulletin of the Industrial Commission of Wisconsin, Vol. I, No. 6, Oct. 1, 1914, pp. 52.)

CALIFORNIA—Industrial Welfare Commission.

First Biennial Report (1913–1914), 1915, pp. 123.

CONNECTICUT—Board of Compensation Commissioners.

First Annual Report . . . for the year ending Sept. 30, 1914, pp. 32. (Connecticut—Public Document, No. 58.)

COWLES, WALTER G.

Agency Expense of Workmen's Compensation Insurance. (Economic World, July 3, 1915, pp. 15–19.)

DENMARK.

Insurance against accidents in agricultural work in Denmark. (Market World and Chronicle, June 26, 1915.—Reprinted from the Monthly Bulletin of Economic and Social Intelligence of the International Institute of Agriculture, Rome.)

ECONOMIC WORLD.

(a) Loss Reserves for Workmen's Comp. Insurance. Oct. 2, 1915.

(b) State Insurance Resting on the Back of Private Insurance. Nov. 20, 1915.

GERMANY.

(a) Die Arbeiterversicherung des Deutschen Reiches. Development, organization, and success of workmen's insurance in Germany, also effects from the war. Serial, 1st part. 2,800 words. (Oest. Zeitschrift Berg & Hüttenwesen, Vienna, Dec. 19, 1914.)

(b) Workmen's Compensation in Germany in 1914. (Market World and Chronicle, May 1, 1915.)

GREAT BRITAIN.

(a) Statistics of compensation and proceedings under the workmen's compensation act, 1906, and the employers' liability

act, 1880, during the year 1913. Cd. 7669. London, Wyman, 1914.

- (b) The Rising Cost of Workmen's Compensation in Great Britain. (Economic World, July 17, 1915.)
- (c) Detailed Results of Workmen's Compensation in Great Britain in 1914. (Economic World, Nov. 13, 1915.)

HANSEN, CARL M.

- (a) Development, Application and Effect of Schedule Rating in Liability and Compensation Insurance. (American Underwriter, May, 1915, pp. 10.)
- (b) A Defense of the Universal Analytic Schedule.—An analysis of Wisconsin Workmen's Compensation experience from the point of view of Schedule Rating. (Econ. World, Sept. 18, 1915.)

HOTCHKISS, W. H.

Workmen's Compensation in New York. (Rev. of Reviews, July, 1915, Vol. 52, pp. 77-81.)

MARKET WORLD AND CHRONICLE.

A Forecast of the Ultimate Cost of Workmen's Compensation in the United States. June 19, 1915.

MASSACHUSETTS.

Massachusetts Workmen's Compensation Experience, in Principal Classifications, July 1, 1912 to Sept. 30, 1914. Monthly Review of the U. S. Bureau of Labor Statistics, Vol. I, No. 3, Sept., 1915, pp. 37-44.)

MASSACHUSETTS—Insurance Commissioner.

Sixtieth Annual Report, Jan. 1, 1915. Boston, 1915. 2 volumes.

Volume II of this report relates to life, miscellaneous, assessment and fraternal insurance, with which is classified the matter relative to workmen's compensation. Two summary statistical tables of operations under the workmen's compensation act by private and mutual companies presented, covering operations up to September 30, 1914.

NATIONAL ASSOCIATION OF INDUSTRIAL ACCIDENT BOARDS AND COMMISSIONERS.

- (a) Workmen's Compensation—Statistics and Cost. (Proceedings of Special Meeting held at La Salle Hotel, Chicago, Jan. 12 and 13, 1915, pp. 58.)
- (b) Report of Committee on Statistics and Compensation Ins. Cost. (Monthly Review, U. S. Bur. of Lab. Statis., Vol. I, No. 5, Nov., 1915, pp. 27-37.)

NEVADA.

- (a) Report of the Nevada Industrial Commission, July 1, 1913, to Dec. 31, 1914. (Carson City, 1915, pp. 108.)
- (b) Report of Investigation in re Claim No. 192, pp. 30.

NEW SOUTH WALES.

Statistical review of annual returns from employers under the Workmen's Compensation Act of 1914. (Dept. of Labor

and Industry, New South Wales Industrial Gazette. Sydney, May, 1915.)

NEW YORK.

- (a) Future of the Workmen's Compensation Amendment. Discussion by: Parkinson, T. I.—Seager, Henry R.—& Hampden Dougherty. (Proceedings, Am. Academy of Political Science, Jan., 1915, pp. 31.)
- (b) Nine Months of State Workmen's Compensation Insurance in New York. (Economic World, July 10, 1915.)
- (c) The Ways of the New York State Fund for Workmen's Insurance. (Economic World, Sept. 11, 1915.)

OHIO.

- (a) Workmen's Compensation in Ohio. (Market World, June 26, 1915.)
- (b) Ohio State Insurance Manual. Rules and Rates, July, 1915, pp. 185.

PENNSYLVANIA.

Report of the Industrial Accidents Commission of Pennsylvania. Philadelphia, 1915, pp. 53.

PROGRESSIVE NATIONAL SERVICE.

Standards of Workmen's Compensation with Annotations. (95 Madison Ave., New York, 1915, pp. 61.)

RUBINOW, I. M.

A Standard Accident Table as a Basis for Compensation Rates. (Quarterly Pub., Amer. Statis. Association, March, 1915, pp. 57.)

SENIOR, LEON S.

Present and Future Developments in the Field of Workmen's Compensation Insurance. (Econ. World, Aug. 28, 1915, pp. 276-9.)

TENNESSEE.

Report of the Workmen's Compensation Commission of Tennessee together with a draft of a bill. Pp. 83.

UNITED STATES.

Workmen's Compensation—Legislative and Administrative Problems. Pp. 129. (American Labor Legislation Review, March, 1915.)

4. *Unemployment Insurance.*

AMERICAN LABOR LEGISLATION REVIEW.

Unemployment. June, 1915, pp. 457.

BRUÈRE, HENRY.

America's Unemployment Problem. (Annals, American Academy, Sept., 1915, pp. 14.)

COMAN, CATHERINE.

Unemployment Insurance. 1915, pp. 21. (Progressive National Service, 95 Madison Ave., New York City.)

FOREIGN COUNTRIES.

Conditions in the labor market and unemployment in foreign countries. (Monthly Review, U. S. Bur. Lab. Statis., Vol. I, No. 4, Oct., 1915, pp. 49-77.)

GATY, THEODORE E.

Some Essential Factors in the Problem of Unemployment Insurance. (Economic World, August 14, 1915.)

GREAT BRITAIN.

Unemployment Insurance. (This topic is discussed monthly in the "Board of Trade Labor Gazette," London.)

ONTARIO.

Interim Report of the Commission on Unemployment, July 15, 1915. (Toronto, 1915, pp. 11.)

5. *Legal Aspects.*

BRODSKY, R. J.

Workmen's Compensation Act, of the State of Pennsylvania, Explained for Employers and Employees. (Philadelphia, R. J. Brodsky, 867 Drexel Bldg., 1915, pp. 35.)

CLARK, LINDLEY D.

Workmen's Compensation and the Federal Congress. (Journal of Political Economy, Oct., 1915, pp. 807-821.)

ECONOMIC WORLD.

The Changing Legal Conception of the Relation of Employer and Employee in respect of Accident. Aug. 7, 1915.

FISHER, WILLARD D.

(a) Field of Workmen's Compensation in the United States. (Am. Economic Review, June, 1915, pp. 221-278.)

(b) American Workmen's Compensation Acts of 1915. (Am. Ec. Rev., Sept., 15, pp. 671-79.)

IOWA—Industrial Commission.

Some Legal Phases of the Workmen's Comp. Act, 1914, pp. 8.

NEW YORK—Superintendent of Insurance.

Fifty-sixth Annual Report. Part I. Fire and Marine Insurance. Albany, 1915. It contains 10 pages on Comp. Legislation in N. Y.

SHERMAN, P. TECUMSEH.

The Jurisprudence of the Workmen's Compensation Laws. (University of Penn. Law Rev., Oct., 1915, pp. 823-875.)

UNITED STATES.

Workmen's Compensation Legislation in the U. S., with a Chart showing the principal features of these laws. (Monthly Review, U. S. Bur. of Lab. Statis., Vol. I, No. 3, Sept., 1915.)

YAPLE, WALLACE D.

Evolution of Workmen's Compensation Legislation. (Bulletin of the Industrial Commission, Columbus, Ohio, Vol. II, No. 1, Jan. 1, 1915, pp. 12.)

C. INDUSTRIAL ACCIDENTS, DISEASES AND POISONS.

1. *Accidents.*

BEYER, D. S.

Industrial Accident Prevention. (Boston, Houghton Mifflin, 1915. \$7.50.)

CALDER, JOHN.

The prevention of accidents in cotton mills. (Econ. World, Sept. 11, 1915.)

CHICAGO—Bureau of Safety.

Accident prevention on a business basis. 2500 words. (Electric Review and Western Electrician, June 5, 1915.)

COLORADO—State inspector of coal mines.

Reports for 1913 and 1914. Denver, 1914, 1915. (2 vols.)

GERMANY.

Knappschafts-Berufsgenossenschaft. Dreissigster Bericht. Berlin, 1914, pp. 69.

It contains a report on the results of accident insurance for the mining industry in Germany for the year 1914.

GERMANY—Imperial Insurance Office.

Jahresberichte der gewerblichen Berufsgenossenschaften über Unfallverhütung für 1913. VII Jahrgang. Berlin, 1914, pp. 687.

This volume contains the reports of the individual trade accident insurance associations of Germany as to their activity in accident prevention.

GREAT BRITAIN—Board of Trade.

(a) General Report upon accidents on railways of the United Kingdom during the year 1914. London, 1915. 17 pp.

(b) Fatal Industrial Accidents. (This topic is treated monthly in the "Board of Trade Labor Gazette," London.)

GREAT BRITAIN—Home Department.

Mines and Quarries. General Report with Statistics for 1914. Part I. London, 1915, pp. 49, map.

HOFFMAN, FREDERICK L.

Industrial Accident Statistics. 210 pp. (Bulletin, U. S. Bureau of Labor Statistics, Whole No. 157; Industrial Accidents & Hygiene Series No. 5. Washington, March, 1915.)

KENTUCKY—Department of Mines.

Annual Report, 1914. Lexington, 1914, 40 pp.

NEW ZEALAND—Department of Labor.

Statistics of Accidents in Factories, and of Accidents Reported under the Scaffolding Inspection Act. (Published monthly in the "Journal of the Department of Labor," Wellington.)

OHIO—Industrial Commission, Department of Investigation and Statistics.

(a) Report No. 4. Industrial Accidents in Ohio, Jan. 1 to June 30, 1914. Columbus, Ohio, 1915, pp. 324.

- (b) Report No. 8. Industrial Accidents in Cuyahoga County, Ohio, from July 1 to Dec. 31, 1914. 43 pp.
- (c) Report No. 11. Industrial Accidents in Mahoning County, Ohio, from July 1 to Dec. 31, 1914. 25 pp.
- (d) Report No. 13. Industrial Accidents in Stark County, Ohio, from July 1 to Dec. 31, 1914. 25 pp.
- (e) Papers on Accident Prevention. (Safety Bulletin, Vol. II, No. 3, March 1, 1915, pp. 80. Illustrated.)

PENNSYLVANIA—Department of Labor and Industry.

Accidents reported during March and April, 1915; Proceedings of the second annual conference on welfare and efficiency. (Harrisburg, Monthly Bulletin, 58 pp.)

PRICE, GEORGE M.

The Modern Factory—Safety, Sanitation, and Welfare. xx, 574 pp.; 257 illustrations. New York, John Wiley & Sons, 1914.

It contains chapters on Factory Accidents and Safety; Industrial Poisons, etc.

TEXAS—Bureau of Labor Statistics.

Third Biennial Report, 1913 and 1914. Austin, 1915. 207 pp.

UNITED STATES.

Digest of boiler laws of States of the United States. 5,000 words. (Power, July 27, 1915.)

UNITED STATES—Bureau of Mines.

Safety in stone quarrying. Washington, 1915. 48 pp. Illustrated. (Technical Paper 111.)

WEST, THOMAS D.

Intoxication, a cause of accidents. Saloons should not be allowed near industrial plants. Illustrated. 3000 words. (Iron Trade Review, April 8, 1915.)

WEST VIRGINIA—Department of Mines.

Annual Report, 1913. Charleston, 1913. 429 pp.

In the chapter on accidents comparative data are given for the period 1883 to June 30, 1913, by year and by cause.

WISCONSIN—Industrial Commission.

Industrial Accidents. July 1, 1912, to Dec. 31, 1914. (Madison, Wis., August 1, 1915. Pp. 52.)

Analyses of 24,000 accidents are presented by industries, by nature, extent and location of injury, and by cause of accident.

WYOMING—State Coal Mine Inspectors.

Annual Report for the year ending Sept. 30, 1914. 36 pp.

2. Diseases and Poisons.

GREAT BRITAIN.

- (a) Occupational Diseases in Factories and Workshops. (This topic is discussed monthly in the "Board of Trade Labor Gazette," London.)

- (b) Report of the Departmental Committee appointed to investigate the danger attendant on the use of paints containing lead. . . . (Cd. 7882), pp. 134. Published May 5, 1915. Report dated Nov., 1914.

HAMILTON, ALICE.

- (a) Industrial Poisons Used in the Rubber Industry. (U. S. Bur. Lab. Statis., Bulletin: Whole No. 179; Industrial Accidents and Hygiene Series, No. 7. Washington, Oct. 1915.)
- (b) Occupational Disease Clinic of New York City Health Department. (Monthly Rev. U. S. Bur. Lab. Statis., Vol. I, No. 5, November, 1915, pp. 7-19.)

OHIO—State Board of Health.

Survey of Industrial Health-Hazards and Occupational Diseases in Ohio. (Columbus, Ohio. Feb., 1915, pp. 438; 101. Illustrated.)

PHELPS, E. B.

Occupational Diseases and Workmen's Compensation Statutes. (American Underwriter, April, 1915.)

UNITED STATES—Bureau of Mines (Department of the Interior).

Pulmonary Disease among Miners in the Joplin District, Missouri, and its Relation to Rock Dust in the Mines: A Preliminary Report. Washington, 1915, pp. 47.

D. MISCELLANEOUS STATISTICS AND GENERAL THEORY.

AUSTRIA—Workmen's Accident Insurance Institute.

Denkschrift der Arbeiter-Unfallversicherungsanstalt für Niederösterreich in Wien über das erste Vierteljahrhundert 1889-1914. Vienna, 1914, pp. 125. Charts and engravings.

This memorial volume is published by the workmen's accident insurance institute for Lower Austria, in Vienna, on the occasion of its twenty-fifth year of existence. The text part of the volume gives a history of the insurance institute, noting the development of insurance methods, matters relating to the fixing and collecting of premiums, compensation procedure, premium tariffs, actuarial results, by-laws and organization, arbitration courts, legal definition of insurance terms, etc.

BRABROOK, E.

Progress of Friendly Societies and other provident institutions during the ten years 1904-1914. (Journal of the Royal Statistical Society, May, 1915, pp. 31.)

COLLIE, SIR JOHN.

Pecuniary Inducement to Malingering. (Market World and Chronicle, May 8, 1915. Reprinted from the "Post Magazine and Insurance Monitor" of London, England.)

COOK, A. J.

Les principaux systèmes d'assurances en usage dans le Royaume-uni (Grande-Bretagne et Irlande). (Journal de la Société de Statistique de Paris, May, 1915.)

DAWSON, MILES M.

Social Insurance in the United States with special reference to the plan of the Westinghouse Electric and Manufacturing Co. 2,000 words. (Electric Journal, March, 1915.)

DEVINE, EDWARD T.

The Normal Life. (New York, Survey Associates, Inc., 1915, pp. 233.)

Among other conclusions, Dr. Devine finds that a well-devised system of social insurance is indispensable to normal life.

FISHER, WILLARD C.

Criticism of Dr. Rubinow's "Standard Accident Table." (See B. SOCIAL INSURANCE—(3) *Workmen's Compensation* of this Bibliography.) (American Economic Review, December, 1915, pp. 903-906.)

FRANCE—Ministère du Travail et de la Prévoyance Sociale.

- (a) Laws and circulars relative to industrial accidents, subsidies to mutual benefit funds, etc. (Bulletin du Ministère du Travail et de la Prévoyance Sociale. Paris, Jan.-April, 1915. (Single issue for 4 months.)
- (b) Social Insurance during the War. (Bulletin du Ministère du Travail et de la Prévoyance Sociale, Paris, May, June, 1915, Nos. 5 and 6.)
- (c) Recueil de Documents sur les Accidents du Travail. (Paris, Ministère du Travail et de la Prévoyance Sociale, 1913 and 1914. Nos. 46, pp. 456; 47, pp. 137, and 48, pp. 108.)

VON FRANKENBERG, H.

Kriegsfürsorge durch Sozialversicherung. (Zeitschrift f. d. ges. Versicherungswissenschaft, Sept., 1915, pp. 16.)

Describes benefits provided to soldiers and their families in war time by the sickness, accident, invalidity, and salaried employees' insurance systems.

GERMANY.

Kriegsfragen der Sozialversicherung. (Zeitschrift f. d. ges. Versicherungswis., May, 1915, pp. 14.)

GERMANY—Imperial Statistical Office.

- (a) Results of workmen's insurance in Germany in 1913 and the period 1885-1913; Principal results of the invalidity and survivors' insurance for 1913; German social insurance during the war; Norwegian sickness insurance results for 1913. (Reichsarbeitsblatt, Berlin, July, 1915.)
- (b) Statistics of decisions relating to accident, invalidity, and survivors' insurance. Decree of Aug. 26, 1915, relating to insurance of salaried employes, etc. (Reichsarbeitsblatt, Berlin, Sept., 1915.)
- (c) Entscheidungen und Mitteilungen des Reichsversicherungsamts. Berlin, 1914, Vol. I, pp. 473.

With the present volume of decisions, rules, and orders, the Imperial Statistical Office begins the publication of a work which, accord-

ing to the preface, is expected to be valuable in the enforcement of the workmen's insurance law and in the understanding of its theory and practice.

GREAT BRITAIN—Chief Registrar of Friendly Societies.

Reports of the Chief Registrar of Friendly Societies for the year ending Dec. 31, 1913. London, 1915, 3 volumes.

HENDERSON, C. R.

Right of the Worker to Social Protection. (Conference of Charities and Corrections, 1914, pp. 355-359.)

HOFFMAN, F. L.

American Problems in Social Insurance. (Conference of Charities and Corrections, 1914, pp. 346-355.)

IRELAND.

Report of the Committee appointed to consider and advise with regard to the application of the national insurance act to out-workers in Ireland. Vol. I. Report Cd. 7685. Vol. II, Evidence and appendices. Cd. 7686. (London, Wyman, 1914.)

NEW JERSEY—Employers' Liability Commission.

Report for the year 1914. Pp. 48, 1915.

RAFFOLOVICH, A.

La guerre, l'assurance obligatoire, les oeuvres d'assistance en Allemagne. (L'Econ. Franç., July, 1915.)

RILEY, THOMAS J.

Social Significance of Industrial Accidents and Occupational Diseases. (Market World and Chronicle, May 15, 1915.)

RUBINOW, I. M.

Social Insurance and the Medical Profession—Address delivered before the Associated Physicians of Long Island at Long Beach, L. I., Oct. 31, 1914. (Journal, American Medical Association, Jan. 30, 1915, Vol. LXIV, pp. 381-6.)

STONE, JOHN T.

Stock Casualty Insurance Companies and Legislation. (Market World and Chronicle, May 22, 1915.)

UNITED STATES.

Classified Summary of Casualty, Surety and Miscellaneous Insurance by States for 1914. (Spectator, Oct. 21, 1915, Supplement.)

VAN SCHAACK, DAVID.

Social Service of Casualty Companies. (Address delivered at the World's Insurance Congress at San Francisco, Oct. 5, 1915. Spectator, Oct. 7, 1915.)

WESTERN AUSTRALIA—Registrar of Friendly Societies.

Reports of Proceedings by the Registrar of Friendly Societies. Perth, 1914, 46 pp.

YOUNG, T. E., and others.

Insurance. With a practical section on Workmen's Compensation Insurance by W. R. Strong and the National Insur-

ance Scheme by Vyvyan Marr. 3d ed., revised and enlarged. xxii, 423 pp. London, 1915, Sir Isaac Pitman & Sons.

E. BIBLIOGRAPHICAL NOTES.

1. The United States Bureau of Labor Statistics has recently issued a Bulletin (No. 174) containing a comprehensive SUBJECT INDEX of the publications of the Bureau since its organization in January, 1885, up to May 1, 1915. It covers 87 miscellaneous reports and 173 Bulletins. Many of these Bulletins contain digests of reports of State bureaus of labor statistics and of foreign statistical publications. Among the numerous subjects indexed in the Bulletin above referred to, the following topics relate to SOCIAL INSURANCE:

Accident insurance; Benefit and retirement systems; Death rates in various industries from accidents, sickness and from all causes; Employers' liability; Fatigue as related to accident occurrence; Industrial poisoning and occupational diseases; Maternity insurance; Old age and invalidity; Pensions and relief funds; Sickness insurance; Unemployment; Widows' and orphans' pensions; Workmen's insurance and compensation.

2. In July, 1915, the United States Bureau of Labor Statistics began the publication of its MONTHLY REVIEW. The purpose of this periodical will be "to make available regularly and promptly notices and summaries of American and foreign official reports of all bureaus, offices and commissions."

3. Beginning with October, 1915, the New York State Industrial Commission has been issuing THE BULLETIN, a monthly publication covering the various activities of the bureaus and divisions under the direction of the State Industrial Commission, such as the State Insurance Fund, the Bureau of Statistics, etc.

4. The United States Commission on Industrial Relations, of which Frank P. Walsh was Chairman, published its FINAL REPORT under date of August 23, 1915 (pp. xv, 448). Among its important recommendations we find an elaborate plan for a FEDERAL SYSTEM OF SICKNESS INSURANCE.

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	† Amerine, W. M., Actuary, Georgia Casualty Co., Macon, Ga.
	† Archer, William C., Second Deputy Commissioner, State Industrial Commission, 1 Madison Ave., New York.
	† Baldwin, F. Spencer, Manager, State Insurance Fund, 1 Madison 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, Office of A. E. Ames & Co., Toronto, Ont.
	† Breiby, William, Office of Fackler & Fackler, Consulting Actuaries, 35 Nassau St., New York.
	† Brodin, Richard, Office of Miles M. Dawson, Consulting Actuary, 141 Broadway, New York.
Oct. 22, 1915	Brown, Herbert D., Chief of 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.
	† 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.
	† 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, A. H., Workmen's Compensation Service Bureau, 18 East 41st St., 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.
- † 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., 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 Traders Casualty Co., Detroit, Mich.
- May 19, 1915 Deutschberger, Samuel, Chief Examiner, Underwriters' Association Bureau, 165 Broadway, New York.
- Oct. 22, 1915 Dickey, D. R., Statistician, Casualty Co. of America, 133 William St., New York.
- † Downey, E. H., Special Deputy Insurance Commissioner, 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, Denver, Col.
- † Fackler, David Parks, Consulting Actuary, 35 Nassau St., New York.
- † Fackler, Edward B., Consulting Actuary, 35 Nassau St., New York.
- † Fallow, Everett S., Travelers Ins. Co., Hartford, Conn.
- † Farrer, Henry, Statistician, Hartford Accident & Indemnity Co., Hartford, Conn.
- Feb. 19, 1915 Fellows, C. W., Manager, State Compensation Ins. Fund, 525 Market St., San Francisco, Cal.

- May 19, 1915 Fisher, Arne, Equitable Life Assurance Society, 120 Broadway, New York.
- † Fitch, Frank M., Auditor, Hartford Steam Boiler & Inspection 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, 1 Madison Ave., New York.
- † Forbes, Charles S., Secretary Liability Department, Casualty Company of America, 133 William St., New York.
- † Franklin, C. H., U. S. Manager, Frankfort General Ins. Co., 123 William St., New York.
- † Furze, Harry, Comptroller, Globe Indemnity Co., 45 William St., New York.
- Feb. 19, 1915 Garrison, Fred S., Superintendent, Burglary and Plate Glass Department, Travelers Indemnity Co., Hartford, Conn.
- † Gaty, Theodore E., 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., Statistician, Travelers Ins. Co., Hartford, Conn.
- † Gould, William H., Secretary-Actuary, Jos. Froggatt & Co., 149 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., Actuary & 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., Secretary, Accident Prevention Department, Workmen's Compensation Service Bureau, 18 East 41st St., New York.
- Oct. 22, 1915 Hatch, Leonard W., Chief Statistician, State Industrial Commission, Albany, N. Y.

- Oct. 22, 1915 Hess, Herbert, Statistician, Massachusetts Bonding & Ins. Co., Boston, Mass.
- † 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., General Manager, Massachusetts Rating and Inspection Bureau, Boston, Mass.
- † 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 & 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.
- May 19, 1915 Johnson, William C., Vice-President & General Manager, Columbian National Life Ins. Co., Boston, Mass.
- Oct. 22, 1915 Kime, Virgil M., Actuary, American Central Life Ins. Co., Indianapolis, Ind.
- † King, Walter I., Actuary, Columbian National Life Ins. Co., Boston, Mass.
- † Kopf, Edwin W., 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.
- † Larkin, J. F., Statistician, Fidelity & Deposit Co., Baltimore, Md.
- † 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.
- † Lehmann, T. A., London & Lancashire Guarantee & Accident Co., 57 William St., New York.
- † Leslie, William, Secretary-Actuary, State Compensation Ins. Fund, 425 Market St., San Francisco, Cal.
- Feb. 19, 1915 Lubin, Harry, State Industrial Commission, 1 Madison 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., Manager, Pennsylvania Inspection Rating 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 & Actuary, Lincoln National Life Ins. Co., Fort Wayne, Ind.
- Oct. 22, 1915 Meeker, Royal, Commissioner, Bureau of Labor Statistics, U. S. Dept. of Labor, Washington, D. C.
- † Michelbacher, G. F., Statistician, Workmen's Compensation Service Bureau, 18 East 41st St., New York.
- † Miller, David, Statistician, Prudential Casualty Co., Indianapolis, Ind.
- † Milligan, Samuel, Metropolitan Life Ins. Co., 1 Madison Ave., New York.
- † Mitchell, J. F., Secretary, Maryland Casualty Co., Baltimore, Md.
- † 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, Kansas Casualty & Surety 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., 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, La Sul America, Rio-de-Janeiro, Brazil.
- † Orr, Robert K., Manager, State Accident Fund, Lansing, Mich.
- † Otis, Stanley L., Actuary, Workmen's Compensation Service Bureau, 18 East 41st St., New York.
- † Pallay, Julius J., Statistician, London Guarantee & Accident Co., Ltd., 134 So. La Salle St., Chicago, Ill.

- † 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., Statistician, Ocean Accident & Guarantee Corporation, 59 John 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 & Secretary, Compensation Inspection Rating Board, 135 William St., New York.
- † Smiley, J. W., Chief Accountant, State of West Virginia Public Commission, Charleston, W. Va.
- Feb. 19, 1915 Smith, George Lambert, Comptroller, New England Casualty Co., 4 Liberty Square, Boston, Mass.
- † Starkey, Edwin, Manager, Bankers International Life Assurance Co., Denver, Col.
- Feb. 19, 1915 Stone, John T., President, Maryland Casualty Co., Baltimore, Md.
- Oct. 22, 1915 Strong, William Richard, Joint 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-General Manager, Utica Mutual Compensation Ins. Corp., 110 Genesee St., Utica, New York.
- † Whitney, Albert W., General Manager, Workmen's Compensation Service Bureau, 18 East 41st St., 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, 1 Madison Ave., New York.
- † Woodward, H. R., New Jersey Manager, Columbian National Life Ins. Co., 31 Clinton St., Newark, N. J.
- † 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.

Date Enrolled	
Oct. 22, 1915	Baxter, Don. A., Assistant Actuary, Michigan Ins. Dept., Lansing, Mich.
Oct. 22, 1915	Brann, Ralph M., Assistant Manager, State Compensation Ins. Fund, Denver, Col.
Oct. 22, 1915	Brockway, U. H., Travelers Ins. Co., Hartford, Conn.
Oct. 22, 1915	Buffler, Louis, Jr., State Ins. Fund, 1 Madison 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. 22, 1915	McGuire, Vincent G., State Industrial Commission, 1 Madison Ave., New York.
Oct. 22, 1915	Müller, Fritz, New York Life Ins. Co., 346 Broadway, New York.
Oct. 22, 1915	Tilson, Howard, Workmen's Compensation Service Bureau, Insurance Exchange, Chicago, Ill.
Oct. 22, 1915	Van Tuyl, Hiram O., Assistant Examiner, New York Ins. Dept., 165 Broadway, New York.
Oct. 22, 1915	Williamson, W. R., 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.

DECEASED FELLOWS.

Date of Death	
Aug. 20, 1915	Montgomery, William J., State Actuary, Boston, Mass. (Admitted Feb. 19, 1915)

July 24, 1915 Phelps, Edward B., Editor, The American Under-
writer, New York. (Charter Member)

SCHEDULE OF MEMBERSHIP, OCTOBER 22, 1915.

	Fellows.	Associates.	Total.
Charter Members, November 7, 1914	97	0	97
Withdrawals:			
By Death	2	—	2
By Resignation	1	—	1
	94	—	94
Additions:			
By Election—Feb. 19, 1915	16	—	16
" " —May 19, 1915	10	—	10
" " —Oct. 22, 1915	14	—	14
By Examination—Oct. 22, 1915	—	13	13
Membership, October 22, 1915	134	13	147

ABSTRACT FROM THE MINUTES OF THE SECOND
ANNUAL MEETING, OCTOBER 22 AND 23, 1915.

The fourth regular meeting of the Casualty Actuarial and Statistical Society of America was held at the Hotel Astor, New York City, on October 22 and 23, 1915.

President Rubinow called the meeting to order on October 22, 1915, at 10.30 A. M. The roll was called, showing the following thirty-nine Fellows and five Associates present:

FELLOWS.

BLACK	GOODWIN	MOWBRAY
BUCK	GOULD	MULLANEY
BUDLONG	HUGHES	ORR
CAMMACK	HUNT	RUBINOW
CRAIG, A. H.	KING	RYAN
CRAIG, J. D.	LAIRD	SCATTERGOOD
DUBLIN	LUBIN	SCHBITLIN
EGBERT	MADRILL	SENIOR
FALLOW	MAGOUN	TRAIN
FISHER	MICHELbacher	WHITNEY
FLYNN	MILLER	WILSON
FONDILLER	MILLIGAN	WOLFE, S. H.
GARRISON	MOORE, G. D.	WOODWARD, J. H.

ASSOCIATES.

BUFFLER	McGUIRE	WOODMAN
FEDER	VAN TUYL	

Messrs. M. A. Brooks, Floyd F. Brown, Buckner Speed and C. H. Waterbury were present as guests of the Society.

The President delivered his annual address.

The minutes of the meeting held May 19, 1915, were approved as printed in the *Proceedings*.

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

Brown, Herbert D., Chief of Efficiency Bureau, Washington, D. C.

Brown, William H., Secretary and Treasurer, Columbian National Life Ins. Co., Boston, Mass.

Dickey, D. R., Statistician, Casualty Co. of America, 133 William St., New York.

Graham, George, Actuary, Missouri State Life Ins. Co., St. Louis, Mo.

Graham, T. B., Metropolitan Life Ins. Co., 1 Madison Ave., New York.

Hatch, Leonard W., Chief Statistician, State Industrial Commission, Albany, N. Y.

Hess, Herbert, Statistician, Massachusetts Bonding & Ins. Co., Boston, Mass.

Hodgkins, L. G., General Manager, Massachusetts Rating and Inspection Bureau, Boston, Mass.

Holland, Charles H., General Manager, Royal Indemnity Co., 84 William St., New York.

Kime, Virgil M., Actuary, American Central Life Ins. Co., Indianapolis, Ind.

Meeker, Royal, Commissioner, Bureau of Labor Statistics, U. S. Dept. of Labor, Washington, D. C.

Rowe, J. Scofield, Vice-President, Aetna Life Ins. Co., Hartford, Conn.

Strong, William Richard, Joint Secretary, London Guarantee and Accident Co., Ltd., London, Eng.

Wilson, Herbert M., Director of Department of Inspection and Safety, The Associated Companies, 2407 First National Bank Building, Pittsburgh, Pa.

After ballot, these nominees were declared duly elected Fellows.

The Secretary's report, which included a statement as to membership as shown in the schedule printed in this number of the *Proceedings*, was accepted.

The Committee on Examinations reported that thirty-two candidates for Associateship had presented themselves for examination on October 6, 1915, throughout the United States and that the following thirteen candidates had passed and been enrolled as Associates by direction of the Council:

Baxter, Don A., Assistant Actuary, Michigan Ins. Dept., Lansing, Mich.

Brann, Ralph M., Assistant Manager, State Compensation Insurance Fund, Denver, Col.

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

Buffer, Louis, Jr., State Insurance Fund, 1 Madison Ave., New York.

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

Levy, S. Leon, Ocean Accident and Guarantee Corporation, 59 John St., New York.

McGuire, Vincent G., State Industrial Commission, 1 Madison Ave., New York.

Müller, Fritz, New York Life Ins. Co., 346 Broadway, New York.

Tilson, Howard, Workmen's Compensation Service Bureau, Insurance Exchange, Chicago, Ill.

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

Williamson, W. R., Travelers Ins. Co., Hartford, Conn.

Wood, Donald M., of Childs, Young & Wood, Insurance Exchange, Chicago, Ill.

Woodman, Charles E., Examiner, New York Ins. Dept., 165 Broadway, New York.

The reports of the Committee on Terms, Definitions and Symbols and the Committee on Workmen's Compensation Statistics were accepted.

A motion was passed that nominations for officers and members of council be by ballot. A motion was also carried that nominations for President, two Vice-Presidents and Secretary-Treasurer be made on the same ballot.

The retiring President, two Vice-Presidents and Secretary-Treasurer having received the highest number of votes after nomination for their respective offices, it was moved and carried that they be declared re-elected for the ensuing year, as follows:

President.....I. M. RUBINOW.
Vice-President.....ALBERT H. MOWBRAY.
Vice-President.....BENEDICT D. FLYNN.
Secretary-Treasurer.....CLAUDE E. SCATTERGOOD.

A letter from Mr. Winfield W. Greene was read, to the effect that, owing to his removal to Denver, Colorado, he was compelled to tender his resignation from the office of Editor-Librarian.

A motion was passed that nominations for Editor-Librarian and two members of council be made on the same ballot.

After nominations and balloting had been completed, the following were declared elected:

Editor-Librarian.....RICHARD FONDILLER
*Member of Council (Term to
 expire October, 1917)*.....HARWOOD E. RYAN
*Member of Council (Term to
 expire October, 1917)*.....JOSEPH H. WOODWARD

Memorials were then read concerning the death of two Fellows, Messrs. William J. Montgomery and Edward B. Phelps.

Papers printed in this number were read or presented.

Luncheon was served at the Hotel Astor during the noon recess.

The Society reconvened on October 23, 1915, at 10.30 A.M., with Vice-President Flynn in the chair.

The reading and presentation of papers was resumed and discussion was had of papers presented at this meeting.

Upon motion, the meeting adjourned at 1 P. M.

CONSTITUTION.

ADOPTED FEBRUARY 19, 1915.

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, and an Editor-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.

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-Librarian 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 Editor-Librarian shall also, 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 1916.* Examinations will be regularly held in May, 1916, 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 1917, 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.

EXAMINATIONS OF THE SOCIETY.

HELD ON OCTOBER 6, 1915.

COMMITTEE ON EXAMINATIONS.

JOSEPH H. WOODWARD (CHAIRMAN)

LOUIS I. DUBLIN

GEORGE D. MOORE

CHARLES S. FORBES

HARWOOD E. RYAN

EXAMINATION FOR ENROLLMENT AS ASSOCIATE.

PART IV. FIRST PAPER.

Time Allowed, Three Hours.

1. Having given the following table of sickness experience, discuss the essential differences in the sickness rate of the two sexes by age:

Sickness Experience of a European Local Sick Benefit Society By Principal Age Periods 1909 and 1912.

Age Period.	Cases of Sickness per 100 Members.				Days of Sickness per 100 Members.			
	1909.		1912.		1909.		1912.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
All ages.....	38.69	38.75	42.46	45.74	1146.66	1350.29	1170.37	1512.09
16-20.....	29.73	27.94	29.96	29.22	701.79	802.89	663.04	768.62
21-25.....	29.88	38.81	32.97	45.76	803.15	1307.20	839.99	1461.99
26-30.....	40.77	50.90	40.87	53.11	1134.64	1890.11	1067.31	1897.02
31-35.....	45.41	58.47	45.95	66.26	1369.49	2259.88	1235.23	2477.52
36-40.....	51.03	65.10	55.72	66.72	1620.66	2508.46	1613.34	2569.44
41-45.....	65.31	79.26	60.64	75.25	2237.94	3169.35	1950.80	2896.69
46-50.....	75.89	91.13	77.55	85.83	2770.20	3541.85	2789.29	3644.28
51-55.....	88.23	97.84	89.57	119.01	3459.55	4455.33	3261.87	4377.44
56-60.....	121.26	115.12	143.23	153.37	5267.69	5190.00	5631.10	6214.96
60 and over.	241.62	252.08	356.19	387.50	11897.30	12647.22	16395.99	19724.26

2. For purposes of analyzing industrial accident statistics what would you consider a satisfactory statement of:

- (a) Cause of injury
- (b) Nature of injury
- (c) Occupation of person injured?

Illustrate your discussion by examples.

3. Illustrate graphically the following table:

Percentage of Various Kinds of Benefits Paid, Sickness Insurance Societies, German Empire, 1907.

Societies.	Physicians.	Medicines.	Sick Benefit.	Hospital Cost.	Other Benefits.	Total.
Local.....	21.69	14.63	44.30	14.10	5.28	100.0
Factory.....	24.29	15.19	45.01	10.38	5.13	100.0
Guild.....	21.22	12.31	41.70	21.76	3.01	100.0
Mutual aid.....	21.17	11.71	55.52	8.26	3.34	100.0
All societies.....	23.11	14.66	44.33	13.21	4.69	100.0

4. (a) What are the principal classifications used in fidelity and surety underwriting?

(b) State the principal points to be considered in determining the loss reserve on fidelity and surety claims.

5. (a) Name the general classifications commonly used in underwriting personal accident insurance and give three occupations falling within each.

(b) How is a change of occupation occurring during the policy term ordinarily treated in practice?

(c) What treatment is usually accorded to cases where the insured is injured while performing the duties of an occupation other than that described in the application?

(d) What is the consensus of expert opinion as to the relative desirability of high hazards underwritten at high rates as contrasted with the better grade of risks at lower rates? Give reasons.

6. (a) What are the principal forms of liability policies? Indicate briefly the coverage under each form.

(b) A manual of liability insurance rates states that the premium for a policy having limits of \$5,000/\$25,000 as compared with that for a policy having limits of \$5,000/\$10,000 is 135 per cent.; for \$10,000/\$25,000, 150 per cent. Assuming that the over-limits on both policies are increased to \$50,000, the table states their cost to be 160 per cent. and 175 per cent., respectively, as compared with the \$5,000/\$10,000 rate. Discuss the applicability of the table where a reinsurance company carries an over-limit of \$25,000 in each case.

7. (a) It is proposed to issue a form of health policy which will be non-cancelable. What scale of benefits and basis of premium rates would you recommend? What premium reserve would be necessary with respect to such policies?

(b) A majority of health policies formerly contained a house-confinement clause. It is proposed to remove this clause in consideration of an additional premium. Discuss the moral hazard involved.

8. (a) Discuss the practical aspects of schedule rating as applied to workmen's compensation risks.

(b) Discuss the probable effect on workmen's compensation experience of the great increase in the manufacture of war munitions in the United States. What points should be considered in estimating the catastrophe hazard in the war munition industries?

(c) Give a brief history of workmen's compensation premium rates in the United States.

PART IV. SECOND PAPER.

Time Allowed, Three Hours.

9 The condensed trial balance of a casualty insurance company
December 31, 1914, was as follows:

	Dr.	Cr.
Losses	\$ 925,000	
Investigation and adjustment	200,000	
Commissions and brokerage	?	
Other expenses	350,000	
Taxes	40,000	
Dividends	100,000	
Investment profit and loss	15,000	5,000
Premiums written		?
Interest		105,000
Mortgage loans	525,000	
Bonds and stocks	?	
Cash	350,000	
Premiums outstanding	650,000	
Consolidated balance account		\$2,870,000
	\$5,780,000	\$5,780,000

Accrued interest was \$30,000; the market value of bonds and stocks was \$1,900,000, being \$100,000 less than the book value; premiums over 90 days due \$40,000; premium reserve \$1,200,000; loss reserve \$675,000; outstanding bills and accounts \$7,500; accrued taxes \$45,000; capital stock \$1,000,000. Supply the missing items in the trial balance and construct from the above data a statement of income and disbursements for the year 1914 and a balance sheet as of December 31, 1914.

10. (a) State what is meant by a financial statement upon a "revenue" basis as distinguished from a "cash" basis, indicating the advantages and disadvantages in practice of each of these forms.

(b) Discuss the theory of the underwriting and investment exhibit and show how the items in this exhibit are compiled from the items in the company's statement.

(c) Show how the earning power of capital invested in a stock insurance company should be calculated.

11. Explain the statutory requirements as to the loss reserve on liability and compensation business as set forth in Section 86 of the

New York Insurance Law. What is your opinion of the reserves produced by the application of this section as respects (a) liability business, (b) workmen's compensation business?

12. (a) What are the requirements in New York State for the formation of a mutual company to transact the business of workmen's compensation insurance?

(b) Describe the method by which the reserves of such a company are required to be computed.

13. (a) Indicate the different forms of workmen's compensation insurance available to an employer under the laws of

- (i) California
- (ii) Michigan
- (iii) New York
- (iv) Ohio
- (v) Wisconsin.

(b) Which form of insurance would you consider most advantageous to a New York employer with large resources and upwards of 10,000 employees? Give reasons.

14. (a) Name three states whose statutes require standard provisions for personal accident policies.

(b) Give in substance three such standard provisions and explain their purpose.

(c) Sketch the conditions which led to the enactment of this legislation.

15. (a) What forms of insurance are included in the definition of accident insurance as set forth in the Canadian Insurance Act?


(b) What is the requirement of the Canadian Insurance Act with respect to deposits to be made by foreign companies as a condition to the transaction of business in Canada?

16. (a) What control, if any, does the state exercise over the rates of casualty insurance companies in

- (i) New York
- (ii) Massachusetts
- (iii) New Jersey?

To what lines of insurance does this apply?

(b) Discriminate between the various forms which state control of insurance rates may assume and briefly indicate the advantages and disadvantages in each case.


WILLIAM J. MONTGOMERY.

By the death of William J. Montgomery on August 20, 1915, this Society and the actuarial profession lost a young member whose work gave promise of a brilliant and useful future and whose genial personality will be greatly missed by those who came to know him.

Dr. Montgomery was born in Worcester, Mass., on August 6, 1886. He was educated at Clark University, graduating with honor with the B.A. degree in 1907 and the M.A. degree in 1909. He pursued his mathematical studies as a graduate student at Chicago and Michigan Universities and received from the latter institution the B.A. degree in actuarial science in 1911. Upon the completion of his studies at Clark University in 1911, he received the degree of Doctor of Philosophy.


On August 1, 1911, he was appointed Assistant State Actuary of Massachusetts, and two months later became State Actuary. Here in connection with the life insurance branch of the Massachusetts savings banks he first came practically into contact with the social insurance movement, with which his natural temperament gave him a ready sympathy.

Although his work as state actuary was primarily with the General Insurance Guaranty Fund of the Savings Banks' Life Insurance Department, he was also called upon for other public work. He made an examination for the Boston teachers of the Boston Teachers' Retirement Fund and made suggestions regarding revision of rates.

In August, 1914, he was appointed by Governor Walsh as a member of the "Commission to Investigate Rates and Practices in Insurance" and was selected by his fellow commissioners as secretary. In the scholarly character of the technical parts of its report may be seen the influence of his presence on the Commission.

Aside from his professional work, Dr. Montgomery was much interested in economic and social problems, wrote for journals and lectured at Clark University and before trade unions and granges on insurance and currency reform.


He was elected a Fellow of the Society on February 19, 1915.




EDWARD BUNNELL PHELPS.

Edward Bunnell Phelps was born in New Haven, Conn., on July 26, 1863, and died in New York City on July 24, 1915. He was a graduate of Yale, a journalist by profession, and a statistician of national and international reputation. In 1894 he established an insurance journal, by the title of *Thrift*, which subsequently was changed to *The American Underwriter*, which deservedly has taken rank as one of the most useful publications of its kind. Mr. Phelps made a number of special contributions to statistics, including papers on war risks, alcoholism, railway accidents, and infant mortality. His most valuable contributions are a series of papers contributed to *The American Underwriter*, on insurance problems of the day.

Throughout his long and useful career Mr. Phelps stood for the highest ideals in journalism and professional statistics. He was a charter member of the Casualty Actuarial and Statistical Society of America, a Fellow of the Royal Statistical Society of England, a Fellow of the American Statistical Association and at the time of his death one of its vice-presidents. He was a man of lovable personality, of the highest integrity, and of exceptional and far-reaching usefulness to insurance and statistics. His early death is a great loss to the Casualty Actuarial and Statistical Society of America, and to insurance interests and statistical science.



SUBSCRIPTIONS TO THE PROCEEDINGS

The PROCEEDINGS will be mailed to persons who are not members of the Society at the following rates: per year, \$3.00; per number, \$1.00.

The Society contemplates publishing at least three numbers of the PROCEEDINGS each year.

Communications regarding the PROCEEDINGS should be addressed to RICHARD FONDILLER, Editor, Casualty Actuarial and Statistical Society, 345 Metropolitan Tower, New York City.

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NUMBER 5

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OF

The Casualty
Actuarial and Statistical
Society of America

FEBRUARY 25, 1916

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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.

PROCEEDINGS

FEBRUARY 25, 1916.

MORTALITY FROM EXTERNAL CAUSES AMONG INDUSTRIAL
POLICYHOLDERS OF THE METROPOLITAN LIFE
INSURANCE COMPANY, 1911-1914.

BY

LOUIS I. DUBLIN.

The "External Causes" considered in this paper form Group XIII of the International List of Causes of Death and include Titles 155 to 186 of this list. The group is, of course, very broad; it is uniform in composition only to the extent that it represents all causal agencies other than disease and the destructive processes that go on either as a result of normal functioning or of maladjustment within the body. The causes in the group we are considering point to forces and processes which are external to the organism. We may subdivide the inclusions into three fairly homogeneous classes: first, suicides; second, homicides; and third, accidents. The last is the largest of the three and is probably of most interest to the members of this Society.

The growth of casualty insurance, the recent spread of compensation legislation, the development of the Safety First movement, the very existence of our Society all point unmistakably to the need for an accurate measure of the prevalence of the external causes of death in the community. The industrial experience of the Metropolitan Life Insurance Company for the year 1914 shows 8,245 deaths from external causes among the premium paying policyholders alone, and these formed 7.7 per cent. of the deaths from all causes. The deaths corresponded to 11,131 claims in an amount of \$1,521,873. We have not only a large number of cases in this experience

but the exposure is in itself a considerable sample of the total industrial population of the United States and Canada. The ten million policyholders in the Industrial Department of the Company include men, women, and children of the working classes who are

TABLE I.

MORTALITY FROM EXTERNAL CAUSES. 1911-1914.

Experience of Metropolitan Life Insurance Company—Industrial Department.

Int'l List No.	Cause of Death.	Number of Deaths.	% of Total Deaths, All Causes.	Death Rates per 100,000 Living.
155-163	All external causes	32,057	7.87	94.4
164	Suicide—all forms	4,369	1.07	12.9
165	Poisoning by food	425	.10	1.3
166	Other acute poisonings	788	.19	2.3
167	Conflagration	406	.10	1.2
168	Burns (conflagration excepted)	2,996	.74	8.8
169	Absorption of deleterious gases	910	.22	2.7
170	Accidental drowning	3,616	.89	10.6
171	Traumatism by firearms	675	.17	2.0
172	Traumatism by cutting or piercing instruments	52	.01	.2
173	Traumatism by fall	4,430	1.09	13.0
174	Traumatism in mines and quarries	461	.11	1.4
175	Traumatism by machines	596	.15	1.8
	Traumatism by crushing	6,683	1.64	19.7
	175A—Steam railroad accidents and injuries	2,972	.73	8.8
	175B—Electric railroad accidents and injuries	1,129	.28	3.3
	175C—Automobile accidents and injuries	1,227	.30	3.6
	175D—Other vehicular accidents and injuries	1,084	.27	3.2
	175E—Other crushing	271	.07	.8
176	Injuries by animals	160	.04	.5
177	Starvation	10	+	+
178	Excessive cold	127	.03	.4
179	Effects of heat	920	.23	2.7
180	Lightning	67	.02	.2
181	Electricity (lightning excepted)	286	.07	.8
182-184	Homicide—all forms	2,378	.58	7.0
185	Fractures (cause not specified)	545	.13	1.6
186	Other external violence	1,157	.28	3.4

especially subject to hazards not only in their occupations but in their every-day life in urban communities. The Metropolitan does not transact an accident insurance business as such, yet its general experience provides the largest body of insurance returns on accidental deaths in the country.

I shall consider the deaths from the above causes in the four years from 1911-1914, inclusive. In all, 32,057 were recorded. Table I gives the number of deaths from the principal causes included in the group, the percentage of total deaths all causes, and the death rate per hundred thousand exposed.

The first title in numerical importance is "traumatism by crushing." This includes the railroad, street car, automobile, and other vehicular accidents. In all 6,683 deaths are represented. Following, in the order mentioned, are "traumatism by fall," "suicide," "accidental drowning," "burns," and "homicides." This order of the inclusions and the death rates per hundred thousand exposed correspond fairly closely with figures for the Registration Area of the United States for the last year available, namely, 1913.

Table II presents a series of death rates per 100,000 for the external causes taken as a group, by color, sex, and age period.

TABLE II.

MORTALITY FROM EXTERNAL CAUSES CLASSIFIED BY COLOR, SEX, AND AGE PERIOD.

Death rates per 100,000 living. 1911-1914.

Experience of Metropolitan Life Insurance Company—Industrial Department.

Age Period.	Persons.	White Male.	White Female.	Colored Male.	Colored Female.
All ages	94.4	145.1	46.0	188.1	57.9
Under 5	97.6	105.0	83.2	152.8	126.5
5-9	51.7	68.6	32.4	70.6	52.4
10-14	42.3	65.6	15.4	86.1	26.0
15-19	65.4	96.6	25.0	182.0	33.2
20-24	83.7	130.1	28.4	231.7	71.1
25-34	93.8	160.0	30.3	248.4	55.0
35-44	108.4	216.3	34.1	213.2	50.3
45-54	132.6	269.8	51.3	196.2	51.7
55-64	180.4	339.2	89.4	220.1	62.9
65-74	297.4	440.2	220.4	299.8	167.9
75 and over	522.8	584.0	506.1	355.4	417.3

Colored males show the highest death rates, all ages combined, namely, 188.1 per hundred thousand; then follow the white males, colored females and white females in the order named. Males in both races have markedly higher death rates than females. Considering the several age periods we note a fairly high rate in the ages under five, which declines until the age period "15-19" is reached; then the rate increases regularly without break among "persons" and among white males and white females.

We shall now analyze the figures for a few of the more important conditions included under the term "external causes." There were 4,369 suicides in the four years covered. Table III presents the death rates per hundred thousand by color and sex, for the several age periods.

TABLE III.

MORTALITY FROM SUICIDE CLASSIFIED BY COLOR, SEX AND AGE PERIOD.

*Death rates per 100,000 living. 1911-1914.**Experience of Metropolitan Life Insurance Company—Industrial Department.*

Age Period.	Persons.	White Male.	White Female.	Colored Male.	Colored Female.
All ages.....	12.9	21.8	6.8	11.4	5.0
Under 5.....	—	—	—	—	—
5-9.....	—	—	—	—	—
10-14.....	.5	.5	.3	1.0	.9
15-19.....	6.9	6.1	8.1	5.4	5.3
20-24.....	14.7	21.4	9.0	18.4	12.2
25-34.....	17.7	30.1	11.0	15.9	8.1
35-44.....	22.2	45.9	10.9	18.7	5.2
45-54.....	26.8	62.1	10.1	14.4	2.5
55-64.....	33.9	79.1	10.2	21.8	2.1
65-74.....	33.9	81.5	9.4	5.2	1.9
75 and over.	38.2	97.7	8.5	—	—

Suicide is a much more frequent cause of death among the whites than among the colored. White males have a death rate close to twice that of colored males at "All ages," the differences being more marked at the advanced years. It is very remarkable that the highest death rate from suicide occurs among white males in the age period "75 and over." Among females the death rate is always low and shows reductions at the advanced ages. Among white females the death rate is less than one tenth as high as among white males at the older ages. The maximum death rate is found in the age period "25-34." The number of cases for colored females is too small to justify comparisons; the death rate is very low, however.

Of the 4,369 deaths, 1,696 or 38.8 per cent. resulted from poisoning. This mode of suicide was most common among females, and especially among the colored females, where 67.5 per cent. of all the suicides were so effected. Firearms accounted for 22.8 per cent. of all suicides, but among the colored males the proportion rose to 37.1 per cent. The proportion of deaths from suicide varies considerably with occupation. The highest proportion is found among bakers, where 5.4 per cent. of all the deaths were from this cause.

Table IV shows the death rates per hundred thousand for homicide, all forms, arranged by color, sex and age period for the four years 1911-1914.

TABLE IV.

MORTALITY FROM HOMICIDE CLASSIFIED BY COLOR, SEX AND AGE PERIOD.

Death rates per 100,000 living. 1911-1914.

Experience of Metropolitan Life Insurance Company—Industrial Department.

Age Period.	Persons.	White Male.	White Female.	Colored Male.	Colored Female.
All ages	7.0	5.3	1.9	52.3	13.5
Under 5 . . . .	.5	.4	.6	1.9	—
5-9 . . . . .	.5	.5	.5	2.0	—
10-14 . . . . .	.9	.8	.6	3.3	.9
15-19	5.5	4.2	1.8	40.4	13.3
20-24	13.2	8.7	3.7	101.8	30.9
25-34	16.4	12.1	3.3	109.3	25.0
35-44	11.3	10.0	3.0	64.7	14.5
45-54	7.0	9.8	2.0	35.5	4.5
55-64	4.6	6.9	1.0	20.9	6.9
65-74	2.9	4.3	1.3	13.0	1.9
75 and over .	2.4	—	—	47.4	15.5

The death rate was highest among colored males, where the figure was 52.3. This is nearly ten times the homicide rate for white males. Colored females show a death rate of 13.5 per hundred thousand; white females a rate of only 1.9 per hundred thousand. Among white males the death rate was highest at the age period "25-34"; this was also observed among colored males, where the startling figure of 109.3 is found. The death rate is not much lower in the preceding age period, "20-24," for colored males, namely, 101.8 per hundred thousand.

Firearms were the commonest mode of homicide, 64.3 per cent. being so effected. The proportion among colored males was 71.6 per cent. Cutting or piercing instruments rank next in frequency as a means of injury.

We have now to consider the third and largest group of the external causes, namely, those popularly designated as "accidents." There were 25,310 such deaths in the experience of this company in the four years stated. Table V presents the death rates per hundred thousand, by color, sex and age period.

TABLE V.

MORTALITY FROM ACCIDENTS CLASSIFIED BY COLOR, SEX AND AGE PERIOD.

*Death rates per 100,000 living. 1911-1914.**Experience of Metropolitan Life Insurance Company—Industrial Department.*

Age Period.	Persons.	White Male.	White Female.	Colored Male.	Colored Female.
All ages.....	74.5	118.0	37.4	124.5	39.4
Under 5.....	97.1	104.6	82.6	150.8	126.5
5-9.....	51.1	68.1	31.9	68.6	52.4
10-14.....	41.0	64.3	14.5	81.8	24.1
15-19.....	53.0	86.3	15.2	136.3	14.6
20-24.....	55.7	100.0	15.8	111.5	28.0
25-34.....	59.7	117.8	16.0	123.2	22.0
35-44.....	74.9	160.3	20.2	129.7	30.6
45-54.....	98.8	197.8	39.2	146.2	44.7
55-64.....	141.9	253.1	78.2	177.4	53.9
65-74.....	260.5	354.3	209.7	281.6	164.2
75 and over.	482.2	486.3	497.6	308.0	401.9

Again the highest death rate at "All ages" is found among the colored males. They are followed by the white males, the colored females and the white females in the order mentioned. In both races, the rate for males is over three times as high as for females. Considering the age periods without distinction of race and sex we find a fairly high rate in the ages under 5, namely, 97.1. The death rate declines appreciably in the next age period and remains fairly constant up to and including the age period "25-34." From this point onward the death rate rapidly rises and attains the high figure of 482.2 per hundred thousand in the age period "75 and over." It is significant that this rate is obtainable on a large exposure, the total number of deaths in this period being 594. Among white males the death rate from accidents is already high at the ages when employment begins, namely, "15-19," where it is 86.3 per hundred thousand. This rate likewise increases with advancing age. The rate for white females remains relatively low at all age periods up to and including "45-54." At the older ages the accidents become extremely frequent, and in the advanced ages "75 and over" the death rate, 497.6 per hundred thousand, is even higher than among white males.

The death rate among colored males reaches a high point earlier in life than among the whites. It is 136.3 in the age period "15-19." Strangely enough, beginning with "35-44" and continuing through the rest of life, the rate for the colored males is lower

than for the white males. Nothing of especial interest is discerned in the accident rates for the colored females.

It was pointed out in Table I that the most important inclusions under the general designation "accidents" are "traumatism by crushing," "traumatism by fall," "accidental drowning" and "burns." The first of these includes railroad accidents, automobile accidents and other accidents referable to vehicles, and other forms of crushing. Table VI shows the death rates per hundred thousand by color, sex and age period for the important group of "steam railroad accidents and injuries."

TABLE VI.

MORTALITY FROM STEAM RAILROAD ACCIDENTS AND INJURIES CLASSIFIED BY SEX AND AGE PERIOD.

Death rates per 100,000 living. 1911-1914.

Experience of Metropolitan Life Insurance Company—Industrial Department.

Age Period.	Persons.	Males.	Females.
All ages	8.8	17.7	1.3
Under 5	1.1	1.5	.7
5-9	2.2	3.7	.7
10-14	3.6	6.5	.7
15-19	8.8	16.5	1.3
20-24	12.1	25.8	.5
25-34	12.3	27.9	1.0
35-44	11.1	26.5	.9
45-54	11.8	27.2	1.8
55-64	16.6	35.7	4.0
65-74	18.0	39.4	4.0
75 and over	18.7	32.5	10.4

The death rates are very much higher for males than for females, the differences becoming more evident during the adult years of life. The highest rate for males is obtained in the age period "65-74," when it is 39.4. The rates do not show any significant differences by color.

An examination of the returns for "burns" shows the very remarkable fact that the death rate is highest at the two extremes of life, namely, in the age periods "under 5" and "75 and over." The rates are respectively 44.5 and 43.0 per hundred thousand in these age periods, the rate for all ages being only 8.8. These differences are to be noted in both races and sexes. The white rate for ages under 5 is 42.0. Among the colored, the rate rises to 76.2 per

hundred thousand in both sexes under age 5. We have here a very clear index of the lack of proper home care for colored children in the earlier years of life. This is shown not only in the rate for burns but in like manner for falls, the colored rate for both sexes combined under age 5 being 13.9 as against 10.4 for white children under 5.

An interesting phase of this accident experience is in relation to the occupations of the deceased. I shall not attempt, however, to refer to this subject here, in view of the fact that a monograph on the occupational mortality experience of the Metropolitan Life Insurance Company is now in the hands of the U. S. Commissioner of Labor Statistics for publication.

In view of the active educational campaign which is being waged all over the country by private bodies to prevent industrial accidents and by the state, through legislation, to check other forms of violence, it is a matter of considerable interest to note the trend of the figures in the above experience during the period under observation. In the interval between 1911 and 1914, the death rate in the Industrial Department of the company showed a gratifying decrease in deaths from "external" causes. In 1911 the rate per 100,000 for "white lives" for all ages was 95.6; in 1914 the corresponding figure was 85.9. This is a reduction of 10.1 per cent. The percentage reduction in the mortality rate of these causes compares favorably with the reduction in the rates for other causes of death. Thus, for tuberculosis (all forms) in the same period the rate was reduced 9.8 per cent. The decline that we have noted is, moreover, not an accidental occurrence, but rather a fairly continuous one from year to year. In all probability we are concerned with a condition which is the result of the steady interaction of many social forces all directed to the reduction of the high accident rate.

In this paper I have purposely refrained from comparing our figures with those for the population and for other insurance companies. It has been my aim rather simply to state the facts as we found them. I am strongly tempted, however, not to close this paper without the comment that even with the reduction that has occurred in the accident rates in the last few years the prevalence of these causes is still too high. A moment's comparison with the returns of the Registrar General for England and Wales will show how unnecessarily wasteful we still are in this country with human life. In the period 1911 to 1914 our death rate for external causes,

white male lives, ages 25-34, was 160.0 per 100,000. This figure is lower than that for the Registration Area of the United States for males of the same period, from 1910 to 1912, namely, 186.2. On the other hand, in 1913 the death rate for the same group in England and Wales was 61.9, or 67 per cent. lower than for the population figure in the United States and 61 per cent. lower than the Metropolitan figure. This unfavorable condition is unfortunately one of constant occurrence. The field for work is still a very fruitful one for those who would through education, efficient business management, legislation and other means reduce the unnecessary loss of life from accidental causes in our country.

ANALYSIS OF THE COST OF 10,307 ACCIDENTS ARISING
UNDER THE NEW YORK WORKMEN'S
COMPENSATION LAW.

BY

JOSEPH H. WOODWARD.

Actual statistics relating to the cost of workmen's compensation claims in the United States are up to the present difficult to obtain. For this reason it is thought that some analysis of the 10,307 accidents reported to the New York State Insurance Fund during the year ended June 30, 1915, the first year of the operation of the act, may not be without interest to the members of this Society.

TABLE A.

INCURRED LOSS, JULY 1, 1914, TO JUNE 30, 1915.

Experience Brought Down to December 31, 1915.

Accidents Reported.	Kind of Injury.	Incurred Loss.	Average per Accident.
72	I. (a) Death: Dependents (including \$6,970 funeral)	\$287,748.88	\$3,997
11	(b) Death: No dependents, funeral only	1,004.50	91
. . .	(c) Suspended mortality	20,276.19	. . .
5	II. Permanent total disability	30,856.34	6,171
224	III. Permanent partial disability—dismemberment	118,719.30	530
2	IV. Permanent partial disability—not dismemberment	7,912.00	3,956
28	V. (a) Temporary total disability—open cases as of December 31, 1915..	81,029.00	2,894
2,127	(b) Temporary total disability—closed cases as of December 31, 1915..	102,922.22	48
0	VI. Temporary partial disability	0	. . .
(1,472)	VII. (a) Medical aid—compensatable cases.	44,874.77	30
4,189	(b) Medical aid—non-compensatable cases	28,301.88	7
3,649	VIII. No loss	0	. . .
10,307		\$723,645.08	

Table A, appended to this paper, shows an analysis of these accidents according to the character of the injury, giving the total

incurred loss under each head and the average cost per accident. The experience in all cases has been brought down to December 31, 1915. This means that at least six months has elapsed between the date of the last accident and the date of the compilation of the experience.

The first point to be mentioned is that these 10,307 accidents are simply "notices." It has been found impracticable to reduce them to terms of "tabulatable" accidents or to apply any other definition of what constitutes an accident. It will, of course, be recognized that the number of "notices" depends largely upon the practice of the employers whose operations are covered by the insurance policies issued. Large employers with well-organized first aid and accident prevention service are likely to report every accident however trivial, while small employers whose operations are not on a sufficient scale to permit of the systematic organization of accident work are not apt to file notices of accident unless the case appears to be sufficiently serious to make it appear probable that either medical aid or compensation will be payable.

To reduce to terms of "compensatable" accidents there must be subtracted from 10,307 the sum of the 3,649 cases in which there was no loss and the 4,189 cases in which, although medical was paid, there was no compensation—7,838 cases in all—leaving 2,469 "compensatable" accidents where the injury caused either death, dismemberment or disability continuing for more than two weeks from the date of the accident. The calculated incurred loss in these 2,469 cases was \$650,468.43, which gives an average of \$263.45 per compensatable injury, not including the cost of medical aid.

With respect to the several items in Table A, the following comments are submitted: Item I shows that out of 83 deaths which occurred up to December 31, 1915, arising from accidents occurring or or before June 30, 1915, 72 were cases involving dependency with an average present value of \$3,997—almost exactly \$4,000—including the "reasonable funeral expenses not exceeding one hundred dollars" stipulated in subdivision 1 of section 16 of the law. These present values were computed upon the basis of the Survivorship Annuitants' Table of Mortality, the remarriage rate of the Dutch Royal Insurance Institution and $3\frac{1}{2}$ per cent. interest. An item of \$20,276.19 "suspended mortality" has been added to the incurred loss to provide the additional reserve for deaths which may arise after December 31, 1915, from accidents occurring previous to June 30, 1915.

Five cases valued as permanent total disabilities are provided for under Item II. These cases have in general been reserved for on the basis of a life annuity at the attained age according to the Survivorship Annuitants' Table of Mortality and $3\frac{1}{2}$ per cent. interest. They represent principally cases of paralysis or spinal injury.

Under Item III is given the data regarding the cases of permanent partial disability arising from dismemberment. The incurred loss in each of these cases is taken as the rate of compensation per week multiplied by the number of weeks' compensation specified in section 15 of the law, the effect of discount for interest and mortality being disregarded for valuation purposes.

Item IV shows that the experience contains only two identified cases of permanent partial disability which does not arise from dismemberment. These figures are further discussed below.

Item V shows that out of 2,155 cases where compensation was awarded for temporary total disability 28 cases remained open on December 31, 1915, in the sense that no evidence was forthcoming on that date that the injured employee had recovered. These cases were valued upon the basis of the reserve values in Table C. This valuation table for open temporary total cases was adopted by the State Insurance Fund after considerable experimental work and is based, after the first thirteen weeks, upon the assumption that an employee who has not recovered after two years from the date of the injury may for valuation purposes be regarded as permanently and totally disabled, and that after the period of thirteen weeks mentioned the value of the liability approaches the total permanent value by equal amounts for equal intervals of time. Since the table has been based upon an average age, it will sometimes happen that when the actual age of the injured employee is taken into account the reserve for permanent total disability will be less than the reserve for temporary total disability. For such cases our rule is to use the reserve for permanent total disability. It is believed that under this method a sufficient reserve is carried on open temporary cases to take care of those cases of permanent disability which may emerge from this class subsequent to the valuation date. In this connection attention may be called to the very great difficulty of distinguishing a case of permanent total disability not due to dismemberment, from a long-term case of temporary disability. It is obviously impossible to follow the terms of the official award in classifying these

cases, for the reason that the law provides that in case of temporary total disability compensation shall be paid to the employee during the continuance thereof, but not in excess of \$3,500. Therefore, it may be, say, five or more years before the Commission is called upon to officially determine whether a given injury will result in permanent total disability, since meanwhile it is merely necessary to continue the case from time to time under awards for temporary disability. Now, it is clear that if statistics as to this matter are to be of real value, they must be based not upon the terms of the official award, but upon the actual facts so far as they may be ascertained to show whether the injury is in all probability a permanent one. This, however, is a difficult matter.

TABLE B.

INCURRED LOSS, EXCLUDING POLICIES NOT COVERING MEDICAL, JULY 1, 1914, TO JUNE 30, 1915.

Experience Brought Down to December 31, 1915.

Accidents Reported.	Kind of Injury.	Incurred Loss.	% of Total Loss.
40	I. (a) Death: Dependents (including \$3,922 funeral)	\$152,834.88	37.3
7	(b) Death: No dependents, funeral only	609.50	
...	(c) Suspended mortality	10,818.19	
3	II. Permanent total disability	14,041.34	3.2
152	III. Permanent partial disability—dismemberment	74,334.30	16.8
2	IV. Permanent partial disability—not dismemberment	7,912.00	1.8
16	V. (a) Temporary total disability—open cases as of December 31, 1915	38,409.00	24.3
1,409	(b) Temporary total disability—closed cases as of December 31, 1915	69,269.22	
0	VI. Temporary partial disability	0	—
(1,472)	VII. (a) Medical aid—compensatable cases	44,874.77	16.6
4,189	(b) Medical aid—non-compensatable cases	28,301.88	
867	VIII. No loss	0	—
6,685		\$441,405.08	100.0

The average value of the 2,155 temporary cases, both open and closed, was \$85.36. The closed cases include cases where no award had been made or where compensation awarded was outstanding and unpaid December 31, 1915, provided the employee had recovered on that date.

In Table B is given an analysis of the 6,685 notices which arose under policies by the provisions of which the cost of medical is borne by the Fund and *not* by the employer. This table permits

TABLE C.
RESERVE VALUES FOR TEMPORARY TOTAL DISABILITY.

Weeks Elapsed Since Accident.	Reserve per \$1.00 of Weekly Compensation.	Weeks Elapsed Since Accident.	Reserve per \$1.00 of Weekly Compensation.	Weeks Elapsed Since Accident.	Reserve per \$1.00 of Weekly Compensation.
1	\$ 2	36	\$280	71	\$630
2	4	37	290	72	640
3	6	38	300	73	650
4	8	39	310	74	660
5	10	40	320	75	670
6	12	41	330	76	680
7	15	42	340	77	690
8	19	43	350	78	700
9	23	44	360	79	710
10	28	45	370	80	720
11	34	46	380	81	730
12	42	47	390	82	740
13	50	48	400	83	750
14	60	49	410	84	760
15	70	50	420	85	770
16	80	51	430	86	780
17	90	52	440	87	790
18	100	53	450	88	800
19	110	54	460	89	810
20	120	55	470	90	820
21	130	56	480	91	830
22	140	57	490	92	840
23	150	58	500	93	850
24	160	59	510	94	860
25	170	60	520	95	870
26	180	61	530	96	880
27	190	62	540	97	890
28	200	63	550	98	900
29	210	64	560	99	910
30	220	65	570	100	920
31	230	66	580	101	930
32	240	67	590	102	940
33	250	68	600	103	950
34	260	69	610	104	960
35	270	70	620		

an estimate to be made of the relative proportion of total compensation payable, which is represented by each of the several classes of benefit provided in the act. Thus the cost of the death benefit

is 37.3 per cent. of the cost of the total, the cost of temporary total disability, 24.3 per cent., of dismemberment, 16.8 per cent., of medical, 16.6 per cent. The accuracy of these percentages depends largely, of course, upon the accuracy of the reserve computations. An exact determination of the problem on the basis of actual results would require many years of completed experience.

It will be of interest to compare the foregoing experience with Doctor Rubinow's "Standard Accident Table." This may conveniently be accomplished by reducing both tables to terms of "compensatable" accidents as follows:

	Rubinow's Table.		State Fund Experience.	
	Actual.	Per 1,000 "Compensatable" Accidents.	Actual.	Per 1,000 "Compensatable" Accidents.
Fatal cases.....	932	24.1	83	33.6
Dismemberments.....	2,323	60.0	24	90.7
Permanent total disability.....	110	2.8	5	2.0
Permanent partial disability other than dismemberment.....	2,442	63.0	2	0.8
Temporary total disability two weeks or over.....	32,049	850.1	2,155	872.9
	38,756	1,000.0	2,469	1,000.0

The almost total absence in the New York figures of permanent partial disabilities other than dismemberment appears to be due in part to differences in the administration of the law as compared with the practice in European countries whose experience formed the basis of Doctor Rubinow's table. Disabilities of this character are often compensated by a lump sum and it seems probable that they may frequently find their way into the statistics as temporary total cases. The greater number of fatal and dismemberment cases in the State Fund Experience is possibly due in part to a greater preponderance of hazardous classifications in the exposures.

STATISTICS NECESSARY FOR COMPUTING NET COMPEN- SATION RATES.

BY

EDWARD OLIFIERS.

The main object of this paper is to determine the abstract actuarial formula of the net cost of workmen's compensation and to indicate on what lines the statistical data must be collected to find such cost. The general form in which the subject has been treated will trace the way to a uniform keeping of statistical data for the different states. The subject is of paramount importance and it justly occupies the attention of committees composed of public representatives.

Let us consider three classes of benefits granted by compensation laws.

I. Death benefits.

II. Permanent partial and total disability benefits.

III. Temporary partial and total disability benefits.

The net premium for each of these benefits is fixed upon by the simple rule of expectation. Mr. W. A. Whitworth writes in the treatise "Choice and Chance," Rule V, page 142, "The expectation from any event is obtained by multiplying the sum to be realized on the event happening by the chance that the result will happen." I neglect to consider the discounting factor due to the deferment in the payment of the benefits, *i. e.*, $V^{\frac{1}{2}}$; an extra safety loading is so introduced.

The following elements will have to enter into this expression of the expectation:

- (a) The accident frequency;
- (b) the effect of the social surroundings such as the distribution by ages of the workmen, the amount of salaries paid, the values of the annuities etc.;
- (c) the legal compensation factors as fixed by the compensation laws.

I. DEATH BENEFITS.

To fix our ideas let us denote by

q_x^d the probability of a workman of age x dying from the results of an accident.

q^d the probability of the death of a workman being caused by an accident.

F_x the number of full workers of age x exposed to the risk of death.

F the number of full workers exposed to the risk of death.

s_x the average salary of a workman at age x .

s_a the average salary of a workman.

B_x^d the mean value of the benefits payable to the claimants of the deceased workman of age x . The legal compensation factor is assumed to be included in this symbol.

The net premium for the death benefits may thus be written:

$$\sum_x^w q_x^d \frac{s_x \cdot F_x}{s_a \cdot F} \cdot B_x^d = \pi_d.$$

If we multiply and divide the expression by q^d we have

$$\sum_x^w q^d \frac{s_x \cdot q_x^d \cdot F_x}{s_a \cdot q^d \cdot F} \cdot B_x^d,$$

putting $q_x^d \cdot F_x = N_x^d$, i. e., the number of workmen killed by an accident at age x ; and $q^d \cdot F = N^d$, i. e., the number of workmen killed by an accident, we have:

$$\frac{q^d}{s_a \cdot N^d} \sum_x^w s_x \cdot N_x^d \cdot B_x^d. \tag{1}$$

Having started with the acknowledgment of a variation of the probability of death according to ages, I have been led to the conclusion that there is no need for such an investigation and that instead all that need be known is the distribution by ages of the workmen killed by an accident.

The statistical data required according to formula (1) are:

- (a) The number of full workers.
- (b) The payroll on which the premium is based which enables us to find the value of s_a .
- (c) The number of workmen killed by an accident at each age.
- (d) The salary at each age on which the compensation benefits have been computed.
- (e) The age of the workman killed and his civil status, the ages of

the annuitants (dependents of the workman fatally injured) and their degree of dependency, longevity, etc.

II. PERMANENT DISABILITY, PARTIAL AND TOTAL.

The formula for the pure premium of this benefit is:

$$\frac{\sum_{a=0}^{a=1} \delta^{(p, a)} \left[\sum_x s_x \cdot P_x^a \cdot F_x \cdot B_x^{(p, a)} \right]}{F \cdot s_a} = \pi_p. \quad (2)$$

P_x^a denotes the probability that a workman of age x be the victim of an accident causing a permanent partial disability of the degree a . When $a=1$ the disability is permanent and total.

P^a denotes the probability that a workman be the victim of an accident causing permanent disability of the degree a .

$\delta^{(p, a)}$ denotes the coefficient of reduction of the salary to obtain the value of the legal allowance.

$B_x^{(p, a)}$ denotes the value of an indemnity of 1 payable to a workman of age x for an accident causing a permanent disability of degree a .

If we write $\delta^{(p, a)} = \delta \cdot a$ where δ represents the legal coefficient of reduction as fixed by the law and if the indemnity is paid as a continuous life annuity the above expression (2) becomes:

$$\frac{\sum_{a=0}^{a=1} \delta \cdot \alpha \left[\sum_x s_x \cdot P_x^a \cdot F_x \cdot \bar{a}_x^{(p, a)} \right]}{F \cdot s_a} = \pi_p.$$

If we multiply and divide the above expression by P , i. e., the probability of a workman being permanently disabled, we have denoting $P \cdot F$ by N^p and $P_x^a \cdot F_x$ by $N_x^{(p, a)}$

$$\frac{P}{s_a \cdot N^p} \sum_{a=0}^{a=1} \delta \cdot \alpha \left[\sum_x s_x \cdot N_x^{(p, a)} \cdot \bar{a}_x^{(p, a)} \right].$$

I have used the indice a in the notation, $B_x^{(p, a)}$ and $\bar{a}_x^{(p, a)}$, to indicate that the degree of disability may have an influence on the value of the annuity.

An approximation to the above expression may be written

$$\frac{P}{s_a \cdot N^p} \left(\frac{\sum_{a=0}^{a=1} \delta \cdot \alpha \cdot N^{(p, a)}}{N^p} \right) \left(\sum_x s_x \cdot N_x^p \cdot \bar{a}_x \right). \quad (2_a)$$

The indemnity paid may thus be said to be made as if the N^p cases of permanent invalidity, total and partial, were

$$\sum_{\alpha=0}^{\alpha=1} \alpha \cdot N^{(p, \alpha)}$$

cases of total permanent disability. It is assumed in (2_a) that the distribution by ages of the persons permanently disabled is uniform whatever the degree of disability.

The statistical data required to allow of a concrete application of the abstract formula (2) for permanent disability, partial and total, are:

- (a) The number of full workers.
- (b) The payroll on which the premium is collected so as to admit of determining s_a .
- (c) The number of workmen at each age incapacitated by an accident causing a permanent disability of degree α .
- (d) The salary at each age on which the benefits have been computed.
- (e) The rates of mortality among permanently disabled lives, consideration being taken of the degree of disability.

III. TEMPORARY DISABILITY, PARTIAL AND TOTAL.

Mutatis mutandis the formula (2) of permanent disability becomes when applied to the temporary disability

$$\frac{1}{52} \cdot \frac{\sum_{\alpha=1}^{\alpha=1} \delta^{(t, \alpha)} \left[\sum_x^w s_x \cdot T_x^\alpha \cdot F_x \cdot t_x^\alpha \right]}{F \cdot s_a} = \pi_t, \tag{3}$$

where T_x^α denotes the probability that a workman of age x will receive an allowance for a temporary disability.

t_x^α denotes the mean duration in weeks of the temporary disability of the degree α .

Multiplying and dividing the expression (3) by T and replacing $T_x^\alpha \cdot F_x$ by $N_x^{(t, \alpha)}$ and $F \cdot T$ by $N^{t, a}$ to designate the number of work-force for a temporary disability of the degree α and all degrees we have:

$$\frac{T}{52 \cdot s_a \cdot N^t} \sum_{\alpha=0}^{\alpha=1} \delta^{(t, \alpha)} \left[\sum_x^w s_x \cdot N_x^{(t, \alpha)} \cdot t_x^\alpha \right].$$

If we assume that the distribution by ages of the persons disabled temporarily, be it partial or total, is the same whatever be their degree of disability,

$$\frac{T}{52 \cdot s_a \cdot N^i} \left(\sum_{a=0}^{a=1} (\delta \cdot \alpha) \frac{N^{(t, a)}}{N^i} \right) \left(\sum_x s_x \cdot N_x^i \cdot t_x \right). \quad (3_a)$$

If the ages and the degree of disability of the persons temporarily disabled are ignored we have

$$\delta \frac{T}{52} \cdot \frac{s_n}{s_a} \cdot t. \quad (3_b)$$

The statistical information required according to the expression (3) are:

- (a) The number of full workers.
- (b) The payroll on which the premium is based which enables us to find the value of s_a .
- (c) The number of workmen at each age incapacitated by an accident causing a permanent disability of degree a .
- (d) The salary at each age on which the benefits have been computed.
- (e) The mean duration of the temporary disability by ages and degree of disability.

In the light of what precedes, it would seem that the statistics have to give the following data to find the cost of the three benefits above mentioned:

- (a) The number of full workers.
- (b) The payroll on which the premium is collected which will allow of determining s_a .
- (c) The number of workmen at each age killed and disabled, be it permanently or temporarily, by an accident and the degree of disability.
- (d) The salary at each age on which the benefits have been computed.
- (e) The age of the workman and the ages of the annuitants (dependents of the workman fatally injured) and their degree of dependency, longevity, etc.
- (f) The rates of mortality among permanently disabled lives, consideration being taken of the degree of disability.
- (g) The mean duration of the temporary disability by ages and degrees of disability. The statistical data to find the med-

ical, the pharmaceutical cost and the cost of other benefits are to be gathered on lines which can be traced without great difficulty.

It must be clearly understood that it is not my contention that nothing less in the form of required statistical data would not give as good results; the simplified formulas for permanent and temporary disability (2_a), (3_a) and (3_b) previously given would still more restrict the number of different statistical data given above, if found to give in the light of actual experience a good approximation to the formulas (2) and (3). Neither is it my contention that more detailed statistical data as, e. g., giving the number of full workers assured at each age, would not be of further assistance in detecting those laws or the causes and nature of the accidents for schedule rating purposes. My contention is simply that the above given formulas admit of a rational determination of the net premium without necessitating an excessive compilation of statistical data. At this point, it may be interesting to draw certain analogies of the above described method of determining the net premium, which may be described as the "prospective method," with what may be termed the "retrospective method" and which consists in finding the net cost by dividing the losses by the payroll. The two methods would give identical results in the purely theoretical case of there being no accidental deviations. But in the light of the study of the workmen's compensation statistics one can but expect these deviations to be appreciable, considering the smallness of the probabilities of accidents, for it is well known that the probability of the deviation is larger when the probabilities of the events considered are smaller.

The ungraduated statistical data will have to be intelligently interpreted and the sagacity of the observer must be directed towards detecting the laws of frequency and correlation in what may seem uncoordinated results. The introduction of these errors of observation in the net premium as found by the retrospective method is objectionable when a more accurate estimation may be made by using the general laws of the calculus of probability. This is more true the smaller the number of observations. Other reasons which make for the superiority of the prospective method over the retrospective method are the observed increasing coefficients of risk, the uncertainty of the estimation of deferred risks, etc.

THE COMPENSATION COST OF OCCUPATIONAL DISEASE.

BY

JAMES D. MADDRILL.

The economic principle that loss of earning power properly attributable to employment should be borne by the consumers of the products is now quite generally accepted. To apply it to the indemnification of disease requires a careful definition of the hazard, if equitable compensation is to be realized with a minimum of litigation. Questions of contributory negligence of employee, assumption of risk, proof of fault of employer, the fellow servant rule, etc., no longer of any considerable moment in the plan of industrial accident indemnification, will probably never seriously affect disease compensation; and it is to be hoped that the problem will not always be unduly complicated by the present very real and exceptional difficulty of distinguishing bona fide occupational diseases from those not actually "arising out of and in the course of" the employment.

Competent inspection and safety engineering may be depended upon to effectively supplement legislation in eradicating unnecessary hazards of disease as well as of accident in trade processes, and the experience of the employers' liability system has demonstrated that the unavoidable destruction of human earning capacity may best be accepted without quibble as properly the burden of the consumer, along with mechanical wear and tear, and applied to the price of the commodity.

Here is a fertile field for the business of insurance, which, once opened to the companies, will be entered with the usual zest and solicitation manifested in scores of other fields, few of which can be compared in importance with the indemnification—and conservation—of human health.

Occupational diseases are defined by Dr. W. Gilman Thompson in his recent book "The Occupational Diseases" as "maladies due to specific poisons, mechanical irritants, physical and mental strain, or faulty environment, resulting from specific conditions of labor." We shall understand "occupational disease" to exclude disease or

infection definitely resulting from accident—taking “accident” in the ordinary sense of the word.

All the statutes evidently contemplate the compensation of disease or infection resulting from accident, whether they so specify or not, but none now enacted in this country appear to intend that occupational disease, as we are taking it, shall be compensated. Experience shows, however, that those statutes using the expression “injury” without the defining phrase “by accident” or its equivalent, are susceptible of interpretation favoring occupational disease claims.

The states and territories having such statutes at the present time are California, Connecticut, Massachusetts, New Hampshire, Ohio, Texas, and West Virginia, with statutes making no reference to disease; and Iowa and Wyoming specifying the exclusion of disease except as it shall result from an *injury* incurred in the employment. Michigan also falls in the class of the seven first named, but it is a singular fact that though the Michigan law is almost identical with that of Massachusetts, the Supreme Court of Michigan has definitely declared against occupational disease compensation while the highest tribunal of Massachusetts takes the equally positive stand that disease if truly occupational and likely to arise from the employment is an injury and compensatable. In the law of the United States, also, reference is only to injury.

The statutes of Hawaii, Indiana, Maryland, Montana, Nebraska, New York (as re-enacted), Oklahoma, Pennsylvania, Vermont and Washington have in effect been rather more closely drawn to admit only such disease as results from accidental injury; and no more liberal interpretation seems likely of the compensation laws of Alaska, Arizona, Colorado, Illinois, Kansas, Louisiana, Maine, Minnesota, Nevada, New Jersey, Oregon, Rhode Island and Wisconsin, which specify accidental injury but make no reference to disease.

No stronger statute reference adverse to occupational disease compensation appears than in the laws of Washington and Montana: “The words injury or injured, as used in this act, refer only to an injury resulting from some fortuitous event as distinguished from the contraction of disease.” Nebraska most clearly defines its position as follows: “The word ‘accident’ as used in this act shall . . . be construed to mean an unexpected or unforeseen event, happening suddenly and violently . . . and producing at the time

objective symptoms of an injury. The terms 'injury' and 'personal' injuries shall mean only violence to the physical structure of the body and such disease or infection as naturally results therefrom. The said terms shall in no case be construed to include occupational disease in any form, or any contagious or infectious disease contracted during the course of employment, or death due to natural causes but occurring while the workman is at work."

The simplest immediate solution approaching equity seems to be the plan that has been in operation in the United Kingdom for ten years, of specifying diseases which shall be deemed as occupational, and compensating them just as accidents are compensated, in accordance with the degree of impairment of earning capacity. The list, as it has been since 1908, except for cataract in glassworkers and telegraphist's cramp brought under the act in December of that year, and writer's cramp first compensated in 1913, is that shown in the second table of this paper. Until effect of occupation upon health has been very much more carefully studied jointly by physicians, engineers and statisticians, it is doubtful whether any practical plan can be devised of closely approaching equitable compensation of all occupational disease. The proposed supplement to the New Jersey act, though designed "to extend the application of the statute to such diseases as can reasonably be diagnosed as due to the occupation"—the first definite American step in this direction—is therefore wisely drawn to cover only specified diseases, fourteen in number, the list being manifestly patterned after the British list of twenty-five, with the notable omission of the mine diseases nystagmus (oscillation of the eye-ball), cellulitis (miner's "beat hand," "beat knee"), bursitis ("beat elbow") and inflammation of the wrist joint, and the addition of anilin poisoning and wood-alcohol poisoning.

The purpose of the present discussion, however, is rather to consider the problem of the compensation of all occupational disease.

For cost figures we are compelled to look to British experience, the only available cost data of any extent being those of the United Kingdom, which are here summarized in Table I from the annual reports of the British Board of Trade for the seven years 1908-1914. The most satisfactory American occupational disease statistics appear to be those gathered for Ohio in 1913-14 by the Ohio State Board of Health Survey* of Industrial Health-hazards and

*Reviewed in *Proceedings*, Vol. II, pages 139-142.

Occupational Diseases under the direction of Dr. E. R. Hayhurst. These furnish no direct basis of estimate of cost of occupational disease, but they have been found very useful as an index of American occupational diseases and as a gauge of their incidence in comparisons with other statistics. Reference has also been made to the results of other state investigations, to the United States Labor Bureau Bulletins, and to the authoritative works of Sir Thomas Oliver and Dr. W. Gilman Thompson; and I am permitted to quote from the results of a preliminary study made in subcommittee of the recent Joint Conference on Workmen's Compensation Rates in New York City.

Table I brings together the cost figures for seven years of British compensation of the diseases listed in Table II, and shows the numbers of cases by industries and the amounts paid throughout the seven years. Many cases run over into other years and in the cost compilations have been counted once for each year in which payments were made. The numbers as increased by these repetitions are stated in the columns which have been given the designation "Payment Years." The ratios of the numbers of payment years and actual amounts paid, to the corresponding accident compensation figures are indicated as percentages in adjoining columns.

In the cost comparisons that we shall make, the first assumption is that the ratios in this table, or in a corresponding table of total incurred expense, would have applied in any American state, on any benefit scale, had American statutes specified compensation for the twenty-five diseases on the British list, and had the incidence of those diseases (as compared with accident) and the numerical distribution of laborers among the industries been the same in both countries.

Mine diseases of the eye and skin, however, for which four-fifths of British disease compensation was paid, anthrax, contracted in the handling of hides and wool imported from oriental countries, and phosphorus poisoning in the match industry, apparently exist to only a very limited extent in America. An investigation in England and Wales showed that in mines where lamps giving one-quarter candle-power were used, two per cent. of the men had nystagmus, while only four-tenths of one per cent. showed symptoms where the lamps were of one-half candle-power. The disease was unknown or very rare among men who worked with open-flame lamps or candles, but was common among those using safety lamps

TABLE I.

DISEASE COMPENSATION, UNITED KINGDOM, 1908-1914 INCLUSIVE, AND COMPARISON WITH CORRESPONDING FIGURES FOR ACCIDENT COMPENSATION.
(Compiled from the published annual reports of the British Board of Trade.)

Industry.	Exposure. Years of Work.	Rel. Size In- dustry, %.	Fatal.				Non-fatal.					Total.				
			Cases.	% of Acct.	Amount Paid.	% of Acct.	Cases.	Paym't Years.	% of Acct.	Amount Paid.	% of Acct.	Cases.	Paym't Years.	% of Acct.	Amount Paid.	% of Acct.
Shipping	1,737,822	3.5	—	—	£—	—	1	1	.00	£ 48	.01	1	1	.00	£ 48	.00
Factories	35,831,039	71.1	226	3.34	36,271	3.76	3,300	4,465	.37	92,119	1.38	3,526	4,691	.40	128,390	1.68
Cotton	4,090,795	8.1	—	—	—	—	17	20	.03	170	.04	17	20	.03	170	.04
Wool, worsted, shoddy	1,983,686	3.9	19	12.75	2,560	16.15	135	156	.76	1,526	1.14	154	175	.85	4,086	2.70
Other textiles ..	1,693,298	3.4	2	2.15	125	1.17	17	17	.09	110	.11	19	19	.10	235	.20
Wood	1,032,292	2.0	5	1.81	786	2.13	39	47	.13	1,507	.47	44	52	.14	2,293	.64
Metal extraction	2,846,987	5.7	36	3.20	5,811	3.38	491	669	.31	16,777	1.55	527	705	.32	22,588	1.81
Engine and ship bldg.	2,007,631	4.0	12	.99	1,722	.94	187	244	.14	5,495	.48	199	256	.14	7,217	.54
Other metal work	5,670,875	11.3	28	2.73	4,012	2.67	541	669	.26	12,778	1.01	569	697	.27	16,790	1.18
Paper and print- ing	2,220,565	4.4	7	4.29	1,045	5.15	110	124	.43	2,280	1.12	117	131	.45	3,325	1.49
China and earth- enware	464,593	0.9	60	92.31	10,217	120.10	397	844	9.83	24,121	50.42	457	904	10.45	34,338	60.94
Miscellaneous ..	13,280,317	27.4	57	2.39	9,993	3.01	1,366	1,675	.51	27,355	1.44	1,423	1,732	.52	37,348	1.67
Docks	890,178	1.8	8	.60	1,169	.57	57	64	.06	1,354	.18	65	72	.07	2,523	.26
Mines	7,411,749	14.7	6	.06	956	.06	25,418	35,583	3.01	514,568	8.60	25,424	35,589	2.99	515,524	6.71
Quarries	611,533	1.2	1	.18	230	.31	12	15	.04	209	.09	13	16	.04	439	.14
Construction	720,245	1.4	2	.27	321	.35	30	47	.10	1,299	.37	32	49	.10	1,620	.36
Railways	3,177,272	6.3	10	.34	2,167	.50	97	140	.09	3,576	.45	107	150	.09	5,743	.46
Clerical staff ...	493,556	1.0	—	—	—	—	2	6	1.45	208	9.44	2	6	1.37	208	3.16
Other employees.	2,683,716	5.3	10	.35	2,167	.50	95	134	.08	3,368	.42	105	144	.09	5,535	.45
Totals	50,379,888	100.0	253	.99	£41,114	1.03	28,915	40,315	1.46	£613,173	3.97	29,168	40,568	1.46	£654,287	3.36

TABLE II.

SEPARATE CASES OF INDUSTRIAL DISEASE FOR WHICH COMPENSATION WAS PAID—UNITED KINGDOM, 1908-1914 INCLUSIVE.

Disease.	Total.	Mines.	Railways.		Factories.													Docks.	Construction.	Shipping.
			Quarries.	Clerical.	Other.	Cotton.	Wool, worsted, Shoddy, Steady.	Other textiles.	Wood.	Metal Extrusion.	Engine, Ship Building.	Other Metal Work.	Paper and Printing.	China and Earthenware.	Miscellaneous.					
Anthrax	233	—	—	—	—	1	111	15	—	—	—	1	2	—	1	62	40	—	—	—
Lead poisoning	2,674	15	2	—	95	3	5	3	42	498	187	533	101	448	697	21	23	1	—	—
Mercury poisoning	40	1	—	—	—	—	—	—	—	1	—	5	1	—	32	—	—	—	—	—
Phosphorus poisoning	2	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—
Arsenic poisoning	46	21	—	—	—	—	—	—	—	2	1	1	3	—	18	—	—	—	—	—
Hookworm	37	37	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Benzene poisoning	153	—	—	—	—	2	1	—	—	—	—	—	—	—	150	—	—	—	—	—
Carbon-bisulphid poisoning	5	—	—	—	—	—	—	—	—	1	1	—	—	—	3	—	—	—	—	—
Nitrous fume poisoning	22	11	—	—	1	1	—	—	—	—	—	—	—	—	9	—	—	—	—	—
Nickel carbonyl poisoning	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
African boxwood poisoning	1	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—
Chrome ulceration	206	1	—	—	—	8	12	—	—	—	—	—	5	—	179	—	—	—	—	—
Eczematous ulceration	253	11	—	—	—	2	23	—	1	3	6	19	7	4	177	—	—	—	—	—
Epitheliomatous cancer	63	3	—	—	—	—	2	1	—	—	—	1	—	1	52	3	—	—	—	—
Scrotal epithelioma	10	4	—	—	—	—	—	—	—	5	—	—	—	—	1	—	—	—	—	—
Nystagmus	9,901	9,898	1	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—
Glanders	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
Compressed air illness	17	—	—	—	—	—	—	—	—	—	1	—	—	—	7	—	—	—	9	—
Subcutaneous cellulitis, hand	5,283	5,228	10	—	9	—	—	—	—	8	—	6	—	—	19	1	—	—	—	—
Subcutaneous cellulitis, knee	8,456	8,452	—	—	—	—	—	—	—	3	—	—	—	—	1	—	—	—	—	—
Acute bursitis, elbow	755	755	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Inflammation synovial lining of wrist joint and tendon sheaths	995	986	—	—	—	—	—	—	—	6	—	—	—	2	1	—	—	—	—	—
Cataract in glassworkers	11	—	—	—	—	—	—	—	—	—	—	—	—	—	11	—	—	—	—	—
Telegraphist's cramp	2	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Writer's cramp (1913, 1914)	2	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
Total	29,168	25,424	13	2	105	17	154	19	44	527	199	569	117	457	1,423	65	32	1	—	—
Fatal	253	6	1	—	10	—	19	2	5	36	12	28	7	60	57	8	2	—	—	—
Non-fatal	28,915	25,418	12	2	95	17	135	17	39	491	187	541	110	397	1,366	57	30	1	—	—

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which give only about one-fifth candle-power with their gauze clogged with coal dust and soot as it is in ordinary use. The prevalence of the disease in Britain and its absence in America is therefore probably to be accounted for in an effective—though perhaps not great—difference in illumination. British coal miners apparently work with little machine help—and 95 per cent. of British miners are coal miners. In America, machines are extensively used, a fact that doubtless has an important bearing on the low reported extent of cellulitis, etc., in this country. Of anthrax, Dr. Thompson says “at present the disease is so much of a rarity in the United States that it is a surprise to find that in eight states it is included in the list of the six reportable occupational diseases, but this is accounted for by the fact that the first American reporting laws were copied almost verbatim from the British.” Dr. Hayhurst says of reported cases in Ohio, “A little investigation of these instances brought us to the conclusion that none were authentic.” It seems therefore that the American incidence of anthrax and of the mine diseases other than nystagmus cannot be over one-quarter of that in the United Kingdom, and that five per cent. is an ample estimate of the relative incidence of nystagmus.

Aside from the “British mine diseases,” the health-hazard by far predominating in both countries is lead poisoning. Referring to conditions in 1910–1911, Dr. Alice Hamilton states in U. S. Labor Bureau Bulletin No. 104 that sanitary regulation had so far reduced the lead hazard in British potteries, that there were in that country at that time, notwithstanding the higher wages and better living conditions in America, only one-fourth as many lead poisoning cases there as here among equal numbers of pottery workers. It is probably reasonable to assume correspondingly improved regulation of the lead hazard in the other British industries, and similar reduction as well of the poison hazards of arsenic, benzine, mercury, etc. On the other hand, by the time compensation for occupational disease may have become regularly prescribed by statute in this country, we may confidently expect that American safeguards against these hazards will have improved with experience and growth of sentiment, to the extent that but two American cases will occur instead of four, in the industrial exposure that results in one British case.

An exact division of cost between what may be termed the “American” and the “non-American” diseases in the British data

is impossible for the reason that the cost figures at hand are not given by diseases. It will be noted, however, from Table II, that in several industries lead poisoning constitutes all but a small part of the disease hazard; in others anthrax predominates; while the mine diseases are prominent only in mining. The figures themselves therefore—with proper allowance for outstanding payments—yield fair average cost values of several of the diseases. It can be shown that except in the smallest industries the completed cost of compensation of the disease claims incurred in any industry during the seven years reported may be expected to be approximately seven times the average sum paid annually in the last two or three years. The results of such estimates are given in the first cost column of Table III. The average cost of a lead-poisoning case comes out at about £50, and of an anthrax case, about £30. It is worth noting in passing that cases ascribed to lead in the china and earthenware industry are evidently quite generally rendered much more severe by accompanying affections, most likely respiratory, as they show an average cost twice the corresponding figure from other industries. Division of cost within the group of principal mine diseases was of necessity by judgment, guided by some statistical information as to relative duration and severity of these cases, and by actual cost figures in the meager experience from quarries.

The following relative cost factors were finally assumed as sufficient for the elimination of the part of the British diseases considered as non-American: lead, 3; pottery "lead," 6; nystagmus and compressed air, 4; anthrax, mercury, phosphorus, arsenic, benzine, carbon bisulphid, nitrous fumes, cancer, glanders, telegrapher's cramp and writer's cramp, 2; and the others, 1; and the result of the elimination is shown, by comparison of the immediate footings of the third and fourth columns of Table III, to cut down the ratio of disease cost to accident cost from 4.6 per cent. to a little over 1 per cent., the estimated total incurred accident cost of the seven years being £22,315,000 (seven times the average annual actual payments of the last three years). As the relative number of lead and other occupational poisonings is expected to be doubled under American conditions, the ratio becomes about 1.9 per cent. This figure assumes the same distribution of workers in both countries in the industries studied. The remaining columns of the table exhibit the calculation of the modification of the factor on the basis

TABLE III.

DISEASE COST BY INDUSTRIES AND COMPARISON WITH ACCIDENT COST.

Industry.	Ratio British Workers to Total in the Seven Industries.	British Disease Cost.		Approximate Distribution Massachusetts Workers in These Industries.	Relative Industrial Distribution Massachusetts to British.	Relative Disease Cost on Massachusetts Industrial Distribution.
		Estimated Complete Seven Years' Claims.	Non-American Diseases Eliminated.			
Shipping.....	3.5%	£ 48	£ 48	1.0%	0.29	£ 14
Factories.....						
Cotton.....	8.1	327	303	12.0	1.48	448
Wool, worsted shoddy....	3.9	6,000	2,400	14.5	3.72	8,928
Other textiles.	3.4	235	104	3.6	1.06	110
Wood.....	2.0	2,740	2,740	3.5	1.75	4,795
Metal extraction.....	5.7	25,100	24,970	0.9	0.16	3,995
Engine and ship bldg...	4.0	8,470	8,430	0.9	0.23	1,939
Other metal work.....	11.3	20,800	20,660	13.4	1.19	24,585
Paper and printing....	4.4	3,320	3,320	6.8	1.55	5,146
China and earthenware	0.9	49,100	49,000	0.2	0.22	10,780
Miscellaneous.	27.4	43,500	42,000	29.2	1.07	44,940
Docks.....	1.8	2,690	1,600	0.4	0.22	352
Mines.....	14.7	850,000	92,600	0.0	0.00	0
Quarries.....	1.2	439	103	0.2	0.17	18
Construction...	1.4	2,100	2,100	9.0	6.43	13,503
Railways.....						
Clerical staff.	1.0	340	340	0.0	0.00	0
Other employees....	5.3	8,160	7,970	4.4	0.83	6,615
Totals.....	100.0%	£1,023,369	£258,688	100.0%		£126,168
Doubled, except mine diseases:		425,000				252,000
Ratios disease to accident cost (estimated incurred accident cost, seven years, £22,315,000):		4.6%				1.9%
Hence expect in America,						
for British industrial distribution:		1.9%				
for Massachusetts industrial distribution:						1.1%

of the distribution of industries and workers in Massachusetts, for which state we have data as to accident cost and distribution by classifications. In arriving at the ratio 1.1 per cent., no account has been taken of the fact that compressed air disease, blindness, loss of the use of members from disease as by paralysis from poisons, etc., regularly compensated under accident provision and reflected in "accident" premiums where disease coverage is not

statutory, would under joint accident and disease provision be accounted occupational diseases—and were so reported in the United Kingdom statistics from which we have derived our cost estimates. Adjustment for this fact would reduce the ratio to something below 1 per cent. The total cost of accidents in Massachusetts relative to payroll in the interval July 1, 1912 to September 30, 1913 was estimated at 0.39 of one per cent. 0.0035 of one per cent. of the payroll of the industries studied is therefore proposed as a fair estimate of the probable cost of compensation of the twenty-five British diseases in these industries in Massachusetts.

The distribution of the 1,204 positive cases and 211 tentative cases of occupational disease discovered by the Ohio Board of Health survey among 236,000 workers in that state may be taken as representative of "all occupational disease" in this country. Nearly all these cases apparently came under the personal observation of the investigators, that is, few of the individuals seem to have been disabled to the extent usually regarded as compensatable; and of course the numbers stated are of existing cases of all durations of standing—not of new cases to be expected annually. Applying a system of cost factors, with calcicosis (lime phthisis), compressed air illness, pneumonokoniosis (lung-dust-disease), and tuberculosis at 4, lead poisoning and occupational neurosis at 3, and the others at 2 or 1, and accumulating the products of "positive cases" by cost factors, first through the list of all the diseases, and then for those only which—by other names—would probably be recognized under the British statute, the relative cost of compensation of all occupational disease to that of the diseases specified in the British act is estimated as approximately 1.8 to 1.

Preliminary to the distribution of the total net cost over the industrial classifications in Massachusetts, quite accordant estimates of the relative seriousness of the disease hazards in all the classifications of the Manual were independently made on a scale from 1, no appreciable special disease hazard, to 5, the maximum hazard, by the Engineering and Inspection Divisions of the Massachusetts Employees Insurance Association and The Travelers Insurance Company. About five per cent. of the total payroll under compensation in Massachusetts fell in Class 2, and about two per cent. in Classes 3, 4 and 5. Of the ninety-odd classifications rated 3, 4 or 5, about half show payroll in Massachusetts. These were studied first, and the disease premiums for Class 2 were then esti-

mated by proper comparisons with those for Classes 3, 4 and 5.

The initial procedure was the careful consideration, with joint engineering and medical advice, of, first, the diseases to which the workmen under each of the classifications in the three more health-hazardous classes were industrially exposed, second, the severity, in "compensation measure," of the average case if contracted, and third, the probability of contraction of such a case. Statistics, though usually altogether inadequate, were fully considered where available, and in the end a fairly satisfactory idea of the relative cost of occupational disease per \$100 payroll for the various classifications was arrived at.

To illustrate, a preliminary value of 13 cents per \$100 payroll, as the total occupational disease cost for iron smelting, was obtained as follows:

Disease.	Cause.	Normal Case.				Prob. of Con- traction, z.	Prob. Annual Cost per \$100 Payroll, $\frac{z}{100}$.
		Medical (W.W.).	Weeks Disability.	Ratio Fatal Cases.	* Av. Cost ¢ (W.W.).		
Gas poisoning	Carbon monoxid, metallic fumes	1	2	.03	6.3	.002	\$.024
Digestion, cramps.	Overheating	1	3	.02	5.2	.002	.020
Eye	Heat, glare, fumes	1	2	—	1.0	.0005	.001
Kidney	Fumes	1	3	.01	3.5	.0005	.007
Rheumatism	Temperature change	1	6	—	3.7	.003	.021
Lungs, throat, etc.	Temperature, moisture, dust	1	8	.04	12.1	.002	.046
Heart, arteries	Over-exertion	1	8	.03	10.3	.0005	.010
Skin	Heat, acid, abrasion	1	2	—	1.0	.002	.004
(Preliminary estimated) pure premium, all occupational disease . . . .							.13

By similar analysis, 9 cents was assigned to lime manufacture, 11 cents to finishing textiles—bleacheries, and so on through the list rated 3, 4 and 5. After extending the list through Class 2 by comparison, all the preliminary premiums were multiplied into the Massachusetts payrolls and the amounts totalled, with a result 0.007 of one per cent. of the aggregate payroll of the state, or twice the estimated cost of compensation of the twenty-five specified diseases in Massachusetts, and according to the other assumptions of

* Basis, present Massachusetts Act; average cost fatal case about 178 weeks' wages, and disability after two weeks compensated at rate of two-thirds wages.

TABLE IV.

Manual Classifications Code.	Process.	Occ. Dis. Hazard Rating.	Pure Prem. for Occ. Dis.	Industrial Health-Hazards.
0100, 1	Tree pruning, spraying, fumigating, etc.	3	4c	Potassium cyanid, prussic acid, arsenate of lead, vitriol.
1412	Gold refining (no ore reduction)	2	3	Sulphuric acid fumes, heat, mercury, lead, potassium cyanid.
1421, 3	Iron smelting	3	6	Carbon monoxid, fumes, heat, moisture, temperature change, fatigue, metal dust, clay dust, glare.
1466	Graphite mfg.	2	3	Dust, heat, temperature change.
1652	Lime mfg.	3	4	Lime dust, fumes, irritants of eyes and skin, carbon dioxid.
1700	Adamant plaster mfg.	2	3	Dust.
1704	Stone crushing	2	2	Dust.
1741	Emery crushing, grinding	2	3	Dust.
1743	Silica grinding	2	3	Dust.
1745	Soapstone mfg.	2	1	Dust.
1780	Emery, carborundum wheel mfg.	2	3	Dust, heat, temperature change.
2080	Stock yards	2	2	Infection.
2081	Slaughtermen	2	2	Infection.
2082	Packing houses	2	2	Heat, dampness, steam, solder.
2171	Cigar, cigarette mfg.—by hand	2	3	Dust, fatigue.
2175	Tobacco mfg.—snuff	2	2	Dust.
2260, 3	Wool combing, scouring, carbonizing	2	4	Dust, fumes, anthrax.
2410	Waterproofing cloth—rubber	3	3	Carbon disulphid, sulphur chlorid, benzine, antimony, lead, wood alcohol, naphtha, mercury.
2411	Waterproofing cloth—not rubber	2	1	Fumes.
2413	Textile dyeing, finishing, printing—new goods	2	3	Dyestuffs, potassium cyanid.
2414	Bleacheries	3	6	Chlorine, hypochlorites.
2430	Oil cloth mfg.	2	3	Fumes, lead, irritants.
2431	Linoleum, cork carpet mfg.	2	3	Dust, fumes, lead, irritants.
2440	Wool separation.	2	4	Dust, fumes, anthrax.

TABLE IV.—Continued.

Manual Classifications Code.	Process.	Occ. Dis. Hazard Rating.	Pure Prem. for Occ. Dis.	Industrial Health-Hazards.
2530	Hat mfg.—felt	5	9c	Mercury, fur dust, steam heat, shellac, wood alcohol, grease, carbon monoxid, emery, sand-paper, nitric acid, arsenic, dyestuffs.
2580-2	Laundries	2	2	Heat, dampness, fatigue, bleaching compounds.
2583	Dyeing, cleaning	2	3	Dyestuffs, benzine, ammonia.
2600	Fur mfg.—preparing skins	3	9	Lime, arsenic, mercury dyes, fur dust, infection, anthrax.
2610	Degreasing skins	2	4	Benzine, anthrax.
2620	Leather mfg.—enamel	2	4	Heat, anilins, amyl acetate fumes.
2621	Morocco dressing	2	4	Heat, fumes.
2622	Leather dressing (n.o.c.)	2	4	Heat, fumes, chrome, anilins.
2623	Tanning	3	7	Lime, lead, dust, naphtha, amyl acetate, chrome, ammonia, anthrax.
2624	Curriers	2	5	Dust, anthrax.
2940	Lead pencil mfg.	2	2	Dust.
2941	Crayon mfg.	2	3	Dust, pigments.
3083	Foundries (n.o.c.)	2	4	Heat, fumes, dust, glare, dampness.
3084	Foundries—bell	2	4	Heat, fumes, glare.
3085	Foundries—brass	3	6	Lead poisoning, fumes, heat, dampness, temperature change, dust.
3120-2	Razor, cutlery mfg.	2	4	Dust, lead, potassium cyanid.
3302	Bedstead mfg.—metal	3	7	Lead, dust, wood alcohol, benzine, amyl acetate.
3312, 3	Copper, zinc goods mfg. (no smelting, rolling)	2	4	Copper, arsenic, lead, antimony, zinc.
3331	Lead works—sheet, pipe, shot (no smelting)	4	20	Lead, arsenic, antimony.
3334	Tin foil mfg.	2	4	Lead.
3335	Babbitt metal mfg.	2	7	Lead, heat.
3337	Galvanizing, tinning sheet metal	3	3	Acid fumes.
3360-3	Oxy-acetylene, electric cutting, welding	2	4	Actinic rays, cyanids.
3370, 2	Plating	2	3	Lead, mercury, acid, fumes, benzine, potassium cyanid.
3631	Machine shops—with foundry	2	4	(See foundries)
3640	Storage battery mfg. from lead plates	4	18	Lead, acid fumes.

TABLE IV.—Continued.

Manual Classifications Code.	Process.	Occ. Dis. Hazard Rating.	Pure Prem. for Occ. Dis.	Industrial Health-Hazards.
3641	Storage battery mfg. from iron, nickel plates	2	2c	Fumes.
3642	Dry battery mfg.	2	4	Dust, fumes, benzol, acids.
3683	Thermometer mfg.	3	8	Mercury.
3687	Photographic supplies mfg.	2	3	Mercury, cyanids, vanadium, potassium permanganate.
3688	Photographic films, dry plates	2	4	Mercury, cyanids, fumes, nitrocellulose.
4014 4030, 1	Potteries, earthenware mfg.—tiling, gas retorts, sewer pipes	4	18	Dust, heat, dampness, lead pigments, sulphur.
4052	Earthenware mfg.—household utensils, art objects	3	12	Dust, pigments.
4100, 10	Glass mfg.	2	5	Heat, light, lead, dust of glass, emery, sandpaper.
4111	Bottle mfg.—no machine blowing	2	6	Heat, light, blowing.
4113	Glass mfg.—cut	3	6	Lead, dust, hydrofluoric acid.
4131	Mirror mfg.—no glass mfg.	3	8	Mercury, acid fumes.
4133	Cathedral, art, stained glass mfg.	2	6	Fumes of turpentine, amyl acetate, wood alcohol, benzine, lead poisoning, chrome.
4150, 2, 3	Optical goods, eyeglass, glass eye mfg.	2	3	Dust, chrome.
4205	Pulp mfg.—sulphite	2	4	Lime, sulphuric acid, fumes, moisture, dye-stuffs.
4278	Fly paper mfg. (no paper mfg.)	3	5	Formaldehyd, fumes.
4301	Wall paper mfg.—designing, printing, etc. (no paper mfg.)	3	15	Arsenic, acid fumes, chrome, anilins.
4350	Electrotyping	2	4	Lead, arsenic, dust, acids.
4360	Motion picture—film development	2	3	(See photography)
4400	Rubber reclaiming	2	4	Benzine, naphtha, gasoline, carbon disulphid.
4410 4432	Rubber goods mfg.	2	5	Carbon disulphid, sulphur chlorid, lead, naphtha, benzine, wood alcohol, mercury, acids.
4440	Celluloid mfg.	2	2	Nitrocellulose, dust, fumes.

TABLE IV.—Continued.

Manual Classifications Code.	Process.	Occ. Dis. Hazard Rating.	Pure Prem. for Occ. Dis.	Industrial Health-Hazards.
4500, 2	Baking powder, soda-bi-carbonate mfg.	2	2c	Carbon dioxid.
4510	Acid mfg. (n.o.c.)	3	10	Fumes, hydrocyanic, hydrochloric, hydrofluoric, nitric, etc.
4511	Analytical chemists	2	4	Various chemicals.
4520	Alcohol, acetic acid mfg.	2	2	Fumes, lime.
4521	Ammonia mfg.	3	8	Fumes.
4523	Disinfectant mfg.	4	13	Chlorine, formaldehyd, sulphur, carbolic acid.
4524	Chemical mfg. (n.o.c.)	3	12	Ammonia, benzol, bromin, carbon bisulphid, chlorin, iodin, nitrous gases, carbolic acid, etc.
4527	Bleaching powder mfg.	4	15	Chlorin, lime.
4528	Creosote mfg.	2	4	Fumes.
4530	Camphor mfg.	2	3	Fumes.
4551	White lead mfg.	5	22	Lead.
4553	Anilin, alizarin mfg.	2	4	Wood alcohol, methyl bromid, methyl iodid, nitrous gases.
4554	Color mfg.—dry	2	4	Anilins, ammonia, sulphuretted hydrogen.
4557	Ink mfg.—printing	2	4	Pyrogallic acid, tannins.
4558	Paint mfg.—no lead mfg.	3	16	Lead, chrome, antimony, turpentine.
4560	Whiting mfg.	2	4	Dust.
4561	Varnish mfg.	2	4	Ammonia, wood alcohol, turpentine.
4580	Fertilizer mfg.	2	3	Bone dust, phosphates, nitric, nitrous, sulphuric, hydrochloric, hydrofluoric and other acids, benzine, infection.
4590-2	Blackings, polishes	2	2	Dust, fumes.
4601	Drug mfg.	2	4	Compounds, alkaloids, etc.
4602	Essential oils mfg.	2	4	Vapors.
4606	Perfumery, flavoring mfg.	2	4	Dimethyl sulphate, essential oils, nitro benzol.
4607	Pharmaceutists	2	4	Chemicals and drugs
4630	Aerated, mineral water mfg.	2	2	Carbon dioxid.
4633	Carbonic acid gas mfg.	3	10	Fumes.
4634	Oxygen, hydrogen mfg.	2	2	Carbon monoxid, chlorid of lime.
4651, 3	Glue, mucilage mfg.	2	2	Fumes, dust, infection.
4714	Soap powder mfg.	2	2	Chlorin, dust.
4740	Oil refining	2	4	Carbon bisulphid, fumes.
4741	Tar mfg. (no coke oven operation)	3	12	Phenol, fumes, sulphuric acid.

TABLE IV.—Continued.

Manual Classifications Code.	Process.	Occ. Dis. Hazard Rating.	Pure Prem. for Occ. Dis.	Industrial Health-Hazards.
4762	Cartridge mfg.	2	4c	Brass.
4763	Acetylene gas tank charging stations—operation	3	7	Fumes.
5461	Painting, decorating, exterior	2	9	Lead, turpentine, wood alcohol, benzine, naphtha.
5462	Glaziers (away from shop)	3	8	Lead.
5490	Painting, decorating, interior (away from shop)	3	14	Lead, dust from sand-papery, dampness, turpentine, wood alcohol, benzine, naphtha.
6250, 3	Caisson work	5	10	Compressed air, carbon dioxide.
6254	Subway tunneling	2	5	Carbon dioxide.
6300	Sewer bldg.	3	5	Carbon dioxide, devitalized air.
7206	Towel, etc. distributing	2	2	Infection.
7500	Gas works	2	3	Carbon monoxid, cyanids, sulphuretted hydrogen.
7585	Sewer cleaning	3	12	Carbon dioxide, sulphuretted hydrogen.
7590	Garbage works	2	2	Infection.
8100, 5	Hide, leather dealers	2	2	Infection.
8200	Paper stock, rag dealers	2	2	Infection.
8801	Hospital employees	2	2	Infection.
9210	Fumigation of bldgs.	3	6	Hydrocyanic acid, formaldehyd and potassium permanganate, sulphur.
9501	Painting, shop only	3	17	Lead, dust, fumes, dampness.
9502	Sign painting, lettering, interior	3	9	As compared with ordinary painting, less lead in paint; less turpentine, benzine, naphtha in paint; little sand-papery; gloves worn.
9504	Enamelling (no metal working)	4	15	Lead, dust, heat, arsenic.
9541	Sign painting, lettering, exterior	3	7	See sign painting, interior.
9600	Taxidermists	3	6	Arsenic, mercury.
9620	Undertakers	2	4	Formaldehyd.

this paper, just about the expected cost of compensation of all occupational disease in that state. The preliminary relative pure premiums have been cut in two, however, as presented in Table

IV, for the reason that with our present inadequate knowledge of the tuberculosis hazard, for example, as affecting office clerks, iron smelters, textile workers, etc., a flat charge of one per cent. of the average accident pure premium, or about 0.004 of one per cent. of the payroll, would perhaps better be levied in addition to the premium quoted in the table.

The results of this paper are proposed as applying not only in Massachusetts, but in any other American state. The premiums for classifications under which there was no issue in Massachusetts have not at the present time been assigned. These and others that may be required in any state may be estimated quite satisfactorily by comparison with the premiums given in the table to classifications known to have comparable disease hazards.

Compensation of all occupational disease will probably not become statutory for some time to come. The premiums in Table IV are submitted, therefore, as representing the more likely cost for those specified diseases which will probably first be written into the statutes.

BIBLIOGRAPHY.

OLIVER, THOMAS.

- (a) *Dangerous Trades*. xxiii, 891 p. 1902. Dutton & Co., N. Y.
- (b) *Diseases of Occupation*. 427 p. 1908. Dutton & Co., N. Y. \$3.00.

THOMPSON, W. GILMAN.

- (a) *The Occupational Diseases*. xxvi, 724 p. 1914. Appleton, N. Y. \$6.00.
- (b) *The Occupational Diseases of Modern Life*. 16 p. (Read before the annual meeting of the Cumberland County Medical Society, Portland, Me., Dec. 8, 1911.)
- (c) *Résumé of the Importance and Prevalence of the Occupational Diseases*. 7 p. (Reprinted from *Medical Record*, William Wood & Co., N. Y., Feb. 3, 1912.)
- (d) *Occupational Diseases in New York*. 7 p. (Reprinted from the *Transactions of the Fifteenth International Congress on Hygiene and Demography*. Sept., 1912.)
- (e) *The Industrial Diseases: their Importance and Methods of Study*. 10 p. (Read before the Academies of Medicine in Buffalo and in Rochester, Apr. 8 and 9, 1913.)
- (f) *Occupational Diseases*. 7 p. (Reprinted from *Medical Record*, William Wood & Co., N. Y., Jan. 31, 1914.)

ILLINOIS.

- Commission Report on Occupational Diseases*. 219 p. 1911. Warner Printing Company, Chicago.

- RAMBOUSEK, J. (Translation by T. M. LEGGE.)
 Industrial Poisoning. 1913. Edwin Arnold, London. \$3.50.
- GOLDMARK, JOSEPHINE.
 Fatigue and Efficiency. 890 p. 1912. Russell Sage Foundation.
 \$3.50.
- LAWES, E. T. H.
 Compensation for Industrial Diseases. 306 p. 1909. Stevens &
 Sons, London.
- ANDREWS, J. B.
 Occupational Disease Compensation; Some Recent Verdicts. (*Survey*, July 18, 1914.)
- JOURNAL OF INDUSTRIAL AND ENGINEERING CHEMISTRY.
 Symposium on Ventilation. Mar., 1914.
- HAYHURST, EMERY R.
- (a) Industrial Health-Hazards and Occupational Diseases in Ohio. xviii, 438 p. 1915. (Issued by Ohio State Board of Health, Columbus, Ohio.)
 - (b) Occupational Brass Poisoning. 11 p. (Reprinted from *Transactions* of Chicago Pathological Society, Vol. VIII, June, 1911. Press of American Medical Association, Chicago.)
 - (c) Occupational Brass Poisoning: Brass-Founder's Ague. (*American Journal of the Medical Sciences*, Vol. CXLV, pp. 723-738, May, 1913.)
 - (d) Critical Examination of One Hundred Painters for Evidences of Lead Poisoning. (*Ibid.*, Vol. CXLVII, pp. 788-803, June, 1914.)
 - (e) The Significance of Occupational Diseases and Their Classification. 10 p. (Reprinted from Ohio State Board of Health, Monthly Bulletin, June, 1913.)
 - (f) The Span of Life in Some Occupations in the State of Ohio. 6 p. (*Ibid.*, July, 1913.)
 - (g) Consumption and Preventable Deaths in American Occupations. 10 p. (*Ibid.*, July, August, 1913.)
 - (h) Occupational Diseases in Their Relation to Rural Districts. 9 p. (*Ibid.*, September, 1913.)
 - (i) Methods and Results of Medical School Inspection in a Cosmopolitan District of 12,000 Inhabitants. 13 p. (*Ibid.*, November, 1913.)
 - (j) Occupational Diseases as They Are Found in Rural Districts. 9 p. (*Ibid.*, December, 1913.)
 - (k) The Health Hazards of Industries with Special Reference to Ohio. 10 p. (*Ibid.*, April, 1914.)
 - (l) Lead Poisoning—Its Chief Causes, with Observations on Its Diagnosis and Prevention. 12 p. (*Ibid.*, May, 1914.)
 - (m) The Prevalence of Occupational Factors in Disease and Suggestions for Their Elimination. 13 p. (Reprinted from *American Journal of Public Health*, Vol. 5, pp. 538-550, 1914. Boston.)
- HAYHURST, EMERY R. AND SCOTT, ERNEST.
 Report on the Investigation of Four Cases of Sudden Death which

took Place at the Athens (Ohio) State Hospital. 15 p. (Reprinted from Ohio State Board of Health Monthly Bulletin, October, 1914.)

OHIO STATE BOARD OF HEALTH.

- (a) Industrial Poisons. 33 p. (Reprinted, 1914, from U. S. Bureau of Labor Bulletin, No. 100, May, 1912, with an index of industries.)
- (b) Laws of Ohio Relating to Occupational Diseases and Industrial Hygiene. 30 p. Nov. 1, 1913.

FRANKEL, LEE K.

Occupational Hygiene. 15 p. (Read before the Detroit Conference, Niagara Falls, Sept. 4, 1913.)

DUBLIN, LOUIS I.

The Reporting of Disease—the Next Step in Life Conservation. 15 p. (Address before Association of Life Insurance Presidents, June 5, 1914.)

PEARSON, ROBERT H.

Occupational Diseases. 32 p. Published by *Weekly Underwriter*, New York, 1915.

TOLMAN, W. H. AND KENDALL, L. B.

Safety. Methods for Preventing Occupational and Other Accidents and Disease. xii, 433 p. 1913. Harper, New York.

PRICE, GEO. M.

Modern Factory. 574 p. 1914. John Wiley & Sons. \$4.00.

MCMURRAY, SAMUEL.

Miners' Nystagmus. (*Colliery Guardian*, London, Oct. 9, 1914.)

GREAT BRITAIN.

- (a) Industrial Poisoning, Accidents and Dangerous Occurrences during 1913. (Board of Trade, Cd. 7309, 1914.)
- (b) Occupational Diseases in Factories and Workshops. (Discussed monthly in Board of Trade Labor Gazette, London.)
- (c) Report of Departmental Committee Appointed to Investigate the Danger Attendant on the Use of Paints Containing Lead. 134 p. (Cd. 7882. Report Nov. 1914, published May 5, 1915.)

GREAT BRITAIN AND IRELAND.

Order Extending the Workmen's Compensation Act. (Interior Labour Office. Bulletin, Vol. IX, pp. 23-24, 1914.)

UNITED STATES BUREAU OF LABOR BULLETIN.

- No. 75, Mar., 1908. Industrial Hygiene. By Geo. M. Kober.
- No. 79, Nov., 1908. Mortality from Consumption in Dusty Trades. By F. L. Hoffman.
- No. 82, May, 1909. Mortality from Consumption in Occupations Exposing to Municipal and General Organic Dust. By F. L. Hoffman.
- No. 86, Jan., 1910. Phosphorus Poisoning in the Match Industry in the United States. By J. B. Andrews.
- List of Industrial Poisons. By Th. Sommerfeld, Thomas Oliver and Felix Putzeys.

- No. 95, July, 1911. Industrial Lead Poisoning in Great Britain and the Western States of Europe. By Thomas Oliver.
White Lead Industry in the United States. By Alice Hamilton.
Deaths from Industrial Lead Poisoning in New York State in 1909 and 1910. By J. B. Andrews.
- No. 100, May, 1912. List of Industrial Poisons. By Th. Sommerfeld and R. Fischer, translated by Wm. H. Rand.
- No. 101, July, 1912. Care of Tuberculous Wage Earners in Germany. By F. L. Hoffman.
- No. 104, Aug., 1912. Lead Poisoning in Potteries, Tile Works, and Porcelain Enameled Sanitary Ware Factories. By Alice Hamilton.
- No. 120, May, 1913. Hygiene of the Painters' Trade. By Alice Hamilton.
- No. 127, Aug., 1913. Dangers to Workers from Dusts and Fumes and Methods of Protection. By William C. Hanson.
- No. 141, Feb., 1914. Lead Poisoning in the Smelting and Refining of Lead. By Alice Hamilton.
- No. 165, Dec., 1914. Lead Poisoning in the Manufacture of Storage Batteries. By Alice Hamilton.
- No. 179, Oct., 1915. Industrial Poisons Used in the Rubber Industry. By Alice Hamilton.

UNITED STATES BUREAU OF MINES.

Pulmonary Disease among Miners in the Joplin District, Missouri, and its Relation to Rock Dust in the Mines: a Preliminary Report. 47 p. 1915.

WORK OF THE STATISTICAL COMMITTEE OF THE BUREAU
OF PERSONAL ACCIDENT AND HEALTH
UNDERWRITERS.

BY

BENEDICT D. FLYNN.

Before going into the work of the Committee a brief review of the development of the coverage under the personal accident insurance policy during the past ten or fifteen years and the condition of accident experience during that period is desirable. As you probably know, the personal accident policy ten or more years ago was a comparatively simple form which paid a certain amount in case of accidental death, say \$1,000, and in case of disability \$5 per week. To this coverage have been added from time to time various features generally called "frills" until today the policy is a bewildering array of special benefits and features—some of very little value, others very expensive and many entirely illogical and unnecessary. We have had the addition of the double indemnity feature, which doubles the payment in case the insured is injured in a particular manner as, for instance, upon a railway train, in an elevator or a burning building; the accumulation feature, which adds annually a percentage of the principal sum insured to the amount payable in case of death; the beneficiary feature, which amplifies the contract so that in case of accidental death of the beneficiary upon a railway train, in a burning building or in some other specified manner of accident the principal sum of the policy is payable; the indemnity provision for partial disability has been increased; hospital and surgical fees have been provided; the double indemnity feature has been extended to treble and quadruple indemnity; policyholders have been granted full accumulations from the date of issue of the contract; indemnity for life in case of permanent and total disability has been provided. These and many other more or less important additions have been made to the policy coverage oftentimes by companies which clearly were not in a position to know the probable cost of the features. Many have been added simply as "talking" points which, if a proper valuation of

the cost could have been made, would have been shown to be most unwise additions to the total cost of the policy.

While the policy coverage was being enlarged from year to year certain new and grave hazards were growing, as for example the automobile hazard and the increase in the hazard of travel. The serious effect upon the cost of the protection in the growth of these hazards is well illustrated by a condition referred to by Mr. B. A. Page, Vice President, The Travelers Insurance Company, in a paper upon the automobile hazard rate at the Second Convention of the International Association of Casualty and Surety Underwriters in 1912. Mr. Page says: "Ten years ago there was practically no such thing as an automobile accident. Last year, claims from select, preferred and ordinary class risks were increased by automobile accidents 28 per cent. and this does not take into account horse and vehicle accidents caused by automobiles, nor injuries to pedestrians and persons on bicycles, motorcycles, etc., who were run over or into by autos." Not only have these hazards been increasing but the accident companies have amplified the coverage of their contracts to risks exposed to these hazards.

In the meantime, rates for the preferred risks (the class to which these policies are offered) have not been increased. For certain of the benefits a small and generally inadequate extra charge has been made, but, generally speaking, no increase in rates has followed the material increase in coverage granted under the contracts.

Recognizing the seriousness of developments, company managers have at various times in the past endeavored to obtain co-operation among the companies with the idea of eliminating some or all of these "frills" and to give proper consideration to the increase in certain hazards. It has been felt by many in the business that the difficulty in coming to an agreement upon this matter has been due to the fact that conclusive statistical evidence as to the expensiveness of some of these features has been lacking. The point of this remark is seen more clearly when it is stated that but few of the companies writing this class of business have paid any attention whatever to the compilation of experience. It is a most remarkable fact that companies with comparatively large volumes of personal accident business have gone ahead in almost complete ignorance of some of the most essential information necessary in the business. The general result has been therefore, as stated before,

that year after year, although certain hazards were increasing, the policy coverage has been expanded by the addition of various novel and many times most expensive features without regard, apparently, to the cost—or without knowledge of the cost—solely with the idea of attracting business by going the competitor one better.

In the meantime, the loss ratios of many of the companies have shown clearly that the business has been conducted at a loss; in the case of many companies at a severe and increasing rate of loss. One of the first acts of the newly formed Bureau of Personal Accident and Health Underwriters, therefore, was to lay plans for the collection of statistical data which would throw light upon the cost of these features and also upon some of the developing hazards of the business with the hope that such experience information would impress upon all of the company managers the urgent necessity for reform. It felt that there was not only a probability that this desirable and necessary object would be accomplished but also that the companies which had given practically no attention to the compilation of accident statistics would take up the matter and with the co-operation and help of the Statistical Committee lay plans for the future handling of the business upon a more intelligent and sound basis.

Accordingly a Statistical Committee of the Bureau, composed of five companies writing personal accident business, was formed which was instructed to take immediate steps toward obtaining the statistical data necessary. The following subjects were pointed out as particularly in need of study:

- (1) Accumulation feature;
- (2) Automobile hazard;
- (3) Life indemnity feature;
- (4) Beneficiary feature;
- (5) Partial disability indemnity feature;
- (6) Hospital and surgeons' fees feature;
- (7) Amounts paid for disfigurement and dismemberment;
- (8) Experience—gunshot wounds.

The Committee in taking up its work decided that, in view of the necessity for early results from the investigation and the desirability of having as many companies as possible contribute to the experience, the plan of work be made as simple as possible. It was found that some companies had experience in rather elaborate form, while others had it in much less complete condition and

others had no experience whatever. In view of this it was decided to call for only the essential information which would give rather rough but reliable information in regard to the cost of the various features and hazards—leaving to the future a more detailed investigation if thought necessary.

The following fundamentals were laid down by the Committee with regard to the plan of the experience examination:

1. Only that experience based upon risks insured in the preferred classes shall be used in the investigation.

This rule was established for the reasons that the great bulk of personal accident business is written in these classes and that not only are the newer hazards, such as automobile and travel, present in the greatest degree among these risks but to these classes are granted those policies which carry the maximum of special features.

2. Experience shall be furnished upon a "policy year" basis; that is, losses shall be related back to the year of business in which the contracts carrying the loss were issued.

3. The experience studied shall cover the ten-year period 1904–1913, inclusive, and shall show results by separate years.

In this way not only could the indications of succeeding years be studied but any combination of years' figures could be made.

4. All premium items shall be reported upon the basis of paid items—as distinguished from a written record—and losses and loss expense shall be reported upon a paid basis with estimates of outstanding items, if any.

The information furnished shall be upon a gross basis; that is, with reinsurance items of premiums and losses not deducted.

The following studies of the experience were then decided upon as well as the forms upon which the information was required:

(A) *Exhibit of Total Experience.*—Total premiums and losses—each division separately for each of the policy years 1904–1913, inclusive—the losses to show number and amount of claims paid, divided by nature of injury into death, dismemberment and indemnity; the dismemberment division to show loss of right hand, left hand, foot or eye.

From the information outlined above the results of all companies combined will be shown by policy year over the ten-year period. In this way any increase in the cost of the total business, according to the main divisions of benefits, can be observed. From this exhibit any tendency of the total business to show poorer or better results from

year to year will be shown; also increases or decreases in the cost of protection by the main divisions of benefits will be indicated. It is thought by the Committee that the seriousness of the trend of the total personal accident business toward underwriting loss—or toward increased underwriting loss—will be brought out in a most convincing manner.

(B) *Accumulation Feature*.—To show clearly the cost of the accumulation feature it was necessary to divide the claim information into that paid for single indemnity accidents and that paid for double indemnity accidents. Under each of these divisions two subdivisions of information were called for: (1) The total amount paid under the contract, including the amount resulting from the operation of the accumulation feature, and (2) the excess amount which was included in (1) and which was due solely to the operation of the accumulation feature.

The above information will show just what extra cost the accumulation feature has caused in each of the ten years of business under single indemnity accidents and under double indemnity accidents (injuries upon railway train, in burning building, in an elevator, etc.).

(C) *Automobile Feature*.—This examination is in two divisions. The first form covering injuries to persons riding in, operating or caring for automobiles, and the second covering losses not provided for in the first form, such as injuries to pedestrians. Under each division the information is shown by number and amount and by nature of injury—death, dismemberment and indemnity—the last including elective benefits, hospital benefits, surgeons' fees, etc., which are shown for each year of the ten-year period. Further, the excess payments which are included in the first examination of the claim information and which are due to the double indemnity feature are shown in a similar manner by nature of injury.

By measuring this information against the total premiums we can obtain a valuable indication of the cost of the automobile hazard viewed from several standpoints. The frequency of such accidents will also be obtained.

(D) *Double Indemnity Feature*.—The analysis of losses under this feature will be made by cause of injury shown for each year of business. The causes by which the claims are to be divided are as follows:

Steam Cars, Burning Buildings,
 Street Cars, Elevators,
 Vessels, Common Carriers—not otherwise classified,
 Lightning, Collapse of Walls,
 Tornado, Steam Boiler Explosion.

For each cause the total claims paid—number and amount—under this feature and the excess payments due to the double indemnity feature (included in the first division of claims just mentioned) will be shown by nature of injury (death, dismemberment and indemnity—including elective benefits, etc.) for each policy year. In case payment is made for triple or quadruple indemnity, provision is made for returning this information upon separate blanks.

The above call for information may appear too complex but the divisions outlined are necessary in order to weigh properly the cost of this most expensive additional benefit.

(E) *Beneficiary Feature*.—In this division losses are to be analyzed simply for the number and amount paid in each policy year.

By placing these claim costs against the total premiums a satisfactory measure of the increase in cost due to the beneficiary feature can be obtained.

(F) *Partial Disability Indemnity Feature*.—Recognizing the difficulty of obtaining information from the companies upon this feature the call for statistics was for three policy years only—1911, 1912 and 1913. The division of losses called for was by amount of total disability for each year and amount of partial disability.

From this information the relative increased cost due to the partial disability feature can be obtained. The expense of this feature, also, as measured against the total premiums, should be enlightening.

(G) *Hospital and Surgeons' Fees Feature*.—It was pointed out by the Committee that the amount paid in excess of weekly indemnity only—not that paid in lieu thereof—was desired.

In this study the total amounts of hospital fees and fixed surgical fees, shown separately, were called for, for each year of the ten-year period.

(H) *Gunshot Wounds*.—The claim information in this case is to be divided into self-inflicted wounds and those not self-inflicted. The number and amount of claims paid by nature of injury in each state for each policy year for these divisions of the claims was called for by the Committee.

The purpose of this investigation is to throw light upon the increasingly large number of claims for gunshot wounds in certain localities.

The Committee considered that the study of the life indemnity feature could best be deferred, particularly in view of the fact that the companies had not as yet obtained sufficient experience to throw light upon its cost. Likewise, an examination of the amounts paid for disfigurement and dismemberment was considered of minor importance at this time and was deferred till a later date.

The question of calling upon the companies for statistics relative to health insurance was gone into by the Committee and it was decided that the cost of the various additional features and increasing hazards of the personal accident business was of most importance at this time and that the work of the Committee along the lines of health experience could be left for the future. The Committee recognized the importance and necessity of work upon health experience but simply deferred it because of the paramount importance of investigation of personal accident experience.

The above is a rough outline of the scope of the work undertaken at this time by the Committee on Statistics. All of the company members of the Bureau have expressed their willingness to co-operate so far as possible in furnishing the experience data requested. Also, those companies which up to this time have paid practically no attention to the compilation of accident statistics or which have done this work only in a most elementary way have recognized the necessity for such work and have agreed to put into operation a plan for obtaining statistical information in the future. Such assurance by company managers indicates an understanding upon their part of the importance and value of work along this line. The Committee, which has had some experience in the past in similar efforts to obtain experience data from the companies, tries not to be too optimistic of the outcome of this investigation. It feels, however, that, in view of the urgent necessity for light upon this subject, the company managers will go to considerable trouble and expense to work out a solution. It hopes at any rate that its work will be productive of valuable results and that the indications given by the experience obtained will be taken to heart by company managers.

* AMERICAN METHODS OF COMPENSATING PERMANENT
PARTIAL DISABILITIES.

BY

I. M. RUBINOW.

In one of my addresses before this Society, I had occasion to point out the difficulty of defining the province of actuarial science and my own preference for as broad a definition as possible, which would cover the entire domain of insurance science. There is a certain tendency in the casualty business to relegate to the actuary only such problems as require computations, whether arithmetical or more highly technical, and then only when the question involved is that of the rate—or broadly speaking the cost and price of insurance. Fortunately for the profession, however, even during its very short life, the Casualty Actuarial and Statistical Society found itself obliged to extend the sphere of its inquiries beyond mere computation and beyond the question of rates, and has begun to study scientifically various problems created in the interrelation between the casualty business and the entire economic and social body politic in which we live and work. Especially significant were the few efforts to extend our line of inquiry into the very substance of insurance—in the case of compensation, into a scientific analysis of the laws themselves, the benefits they grant, and other features of their application. It must be admitted that there was comparatively little accurate information on compensation theory when most of the American compensation laws were passed. A priori then, it would appear very probable that they would be full of shortcomings.

Anyone who has taken the time and trouble necessary to study the thirty-three acts in detail, will at once admit that the probability becomes a certainty, and that a very large book may be written about errors more or less obvious which all of these acts contain, beginning with bad spelling or faulty grammar, and up to provisions which are often economically unsound, and socially harmful. I know of no one organization in this country which is better able to subject these many acts, and the prodigious variety of these

provisions, to a careful, impartial, scientific analytic study, than is the Casualty Actuarial and Statistical Society of America. Studies like those of Mr. Michelbacher must therefore, it seems to me, be welcomed and encouraged on our programs.

One may readily recognize that on embarking upon this undertaking, an actuary may easily find himself on thin ice, and that a certain amount of tact will be necessary lest one run the chance of breaking through. A good many problems which must arise from the study of compensation legislation, are highly controversial; not only among the members of the Society, but also, and even more, among the various insurance organizations they are professionally connected with, a wide divergence of opinion exists, often accompanied by a certain bitterness or tension, because, underlying the clash of opinions held, there may be a very material divergence of economic interests concerned. These factors, however, influence the discussion of all such problems anywhere, and it is well to remember that if the Society is not responsible for statements made or opinions expressed in these meetings, neither are the particular types of insurance organizations or individual insurance carriers, with which the author of any paper may be connected. There is a very healthy attitude assumed by insurance carriers which is well expressed, I believe, in Mr. Cowles' aphorism "Let the state make the law, and the insurance company will make the rate," but that should manifestly not interfere with the individual insurance expert discussing or criticizing the law.

Since the final purpose of workmen's compensation is not to create business for casualty companies, not to stimulate mutual or state insurance, but to relieve certain causes of destitution among wageworkers, the final test of compensation must necessarily be not the provision concerning insurance, not administrative regulations, not the absence or presence of public rate control, but the compensation scale and its correspondence to the economic distress caused by injuries; and if the actuary be assumed to deal primarily in quantitative relations, the proper judgment of a compensation scale becomes largely an actuarial problem. If the proper solution of this problem depends upon statistical data, this again offers a point of contact with other actuarial problems.

It is a fact well known to all students of compensation matters, that in the thirty-three compensation acts in force in this country, no two are exactly alike. The same is true even if only the com-

compensation scales of the acts are compared, and all other legal and administrative provisions are disregarded. The comparative study of any one feature of the law becomes, therefore, a matter of great technical difficulty, and any problem must be divided and subdivided before such a comparative study is undertaken.

In this paper I intend to make but a brief review of the general principles underlying the compensation of only one class of industrial injuries—those known as permanent partial disabilities.

It will be readily admitted that these constitute the most important class of injuries from a social point of view, the most difficult to handle from an administrative point of view, and on the whole, perhaps the least satisfactorily handled in American legislation.

Individually, cases of permanent partial disability in the severity of economic consequences occupy a middle ground between fatal cases or cases of permanent total disability on one hand, and those of total temporary disability on the other. The latter is very much the more numerous group, but the effect of the injury being temporary, and the final result complete restoration of health and working capacity, the economic problems created are perhaps serious, but not necessarily grave and their solution, at least theoretically, does not offer any great obstacles.

On the other hand, permanent total disability is a very distressing condition, but fortunately one of great rarity. My assumption of about one tenth of one per cent. in the Standard Accident Table has already been criticized as excessive, and though I am not ready to admit it, it is nevertheless evident that in the total volume of industrial accidents, the cases of permanent total disability are destined to remain as isolated, rare cases. Moreover, a healthy tendency is already noticeable to provide life pensions for such cases in an increasing number of states.

Fatal cases, to be sure, present many distressing economic features, which are not always met by an arbitrarily limited number of weeks of compensation. But after all, in many fatal cases, this limited number of weeks may be sufficient to bring children to the age of self-dependence.

Permanent partial disabilities are much more frequent than fatal cases (according to the standard accident table, five times as frequent, and according to the statistical data of some foreign countries, even much more numerous). They create families of semi-dependents, they must depress the standard of living of thousands

of families, and blight the hope of advance for thousands of children. If the estimate of some 30,000 fatal accidents per annum is at all correct, and if the assumption of the Standard Accident Table is at all correct, then from 100,000 to 150,000 permanent partial disabilities must be incurred in this country. The workmen who do suffer them are not totally disabled, many of them may retain sufficient earning capacity to remain economically self-sufficient; others, however, may become partially dependent upon charitable or other outside relief, a consequence of industrial injuries which it is the direct duty of compensation laws to prevent.

If we turn to Europe, where most countries possess a rich experience in workmen's compensation, and where, after all, our own compensation movement has arisen, we find well-defined methods of compensating permanent partial disability, or at least one fundamental principle underlying it—and that is the principle of partial benefits for partial loss, to last as long as the disability lasts. The equity of such an arrangement is apparent. The fundamental provisions of the act determine how the economic loss sustained through the disability to earn wages should be apportioned between employer and employee, or perhaps more accurately, between industry and employee, or still more precisely, between society at large and the injured person himself. If the answer is "an equal share" we have a 50 per cent. compensation standard; if it seems fairer to decrease the injured person's share of the burden, the compensation rises to 60 per cent., 66 $\frac{2}{3}$ per cent., 70 per cent., or even 80 per cent. of the loss. Be that as it may, this standard, once established, is applied to partial disability. If the loss sustained is only 50 per cent. of the earning capacity, that loss serves as the basis for compensation, which thus supplements instead of entirely substituting wages.

As to the duration of these partial benefits, the same rule as to the total benefits at least theoretically applies: if the partial disability is truly permanent, *i. e.*, lasts for the remainder of life of the injured, the need of the compensation is evidently just as permanent.

It is true that in some countries commutations of benefits to lump sums are permitted and extensively practiced. That, however, raises an independent problem of lump sum settlements, their wisdom or desirability, methods of safeguarding necessary, etc., which had better be kept outside of the scope of this paper. It is suffi-

cient to state here that when the reduction of the earning capacity is slight, and the resulting compensation therefore, when expressed in weekly amounts, becomes almost nominal, so that it does not affect the budget substantially one way or the other, commutation of the provision becomes desirable for all parties concerned. But even, then, it must not be forgotten that the compensation becomes largely a psychologic balm to injured feelings—something compensation was not at all intended for, or at least something which is not the primary social function of compensation. It becomes a bonus for suffering and perhaps it may be argued that such bonuses are on the whole desirable. But evidently they are not important.

There is no doubt that the European method of partial compensation for partial disability presents its practical difficulties. The determination of the amount of compensation depends upon the determination of the degree of disability or loss of earning capacity, and the latter is not as simple as it might appear at first glance. To be sure, the final proof of the pudding is in the eating, and the loss of earning capacity should express itself in the actual earnings. But wage statisticians know that even the answer to the simple question—What is wages?—often presents serious difficulties, and still more difficult at times is the determination of the effect of each one of many conflicting influences upon wages. The normal wage curve of any worker is not a straight line throughout his life. On the contrary, it is a curve whose configuration is subject to dozens of various factors. Any exhaustive discussion of them at this place is quite impossible. But just to enumerate them—there is the influence of advancing age, the acquisition of experience, or loss of speed or dexterity, the effect of general health irrespective of the specific permanent injury, the effect of the season, of general trade conditions, of possible changes in the specific trade, etc., and in addition there are substantial differences between individuals in the power of adjustment, differences temperamental, physical or moral. Logicians have warned us against the general fallacy of the assumption “post hoc ergo utque hoc” and surely it would be dangerous to assume that all wage modifications which come subsequent to the injury sustained, are necessarily due to that injury; perhaps equally misleading would be the assumption that if the wage remains the same, no permanent harm has been done; the natural tendency of the wage to rise may have been destroyed.

Thus the difficulties of accurate determination of the degree of disability have been frankly stated. An additional obvious difficulty is created by the necessity of keeping the case open—in insurance language—for an indefinite period. But while these difficulties are real, they need not be used as evidence of the impossibility, or even impracticability of basing compensation upon degree of disability. At least in Europe, where these difficulties have been very clearly recognized, the method has not been abandoned, but practice has clearly established the following principles:

1st. That it is often impracticable to determine the degree of disability from actual wages only, and that expert opinion of the injury in relation to the industry becomes necessary.

2d. That subject to the right of reconsideration, the determination may often better be made ahead, rather than after the reduced wages have actually been earned.

3d. That in the absence of absolute standards, compromise or arbitration may often become necessary, as in all human controversies, and that in themselves such compromises do not represent any distressing condition, provided there is a common-sense system of procedure.

The application of these methods in Germany and other countries has often been criticized as cumbersome, complex, and difficult. But while all efforts towards simplicity and speed are legitimate, why should we expect the adjudication of these cases to be so simple? The social problems involved are complex. The purpose of compensation is not arithmetical simplicity or actuarial accuracy, but "social justice," much as this term has been abused. A wage worker, with a family of dependents, and with a definite standard of living, who suddenly, through an injury, finds himself a cripple for life, and with his earning capacity permanently reduced, represents a serious social problem. He must receive reasonable compensation, yet he must be encouraged in reasonable effort toward a complete adjustment, so as not to remain a charge upon society any longer than necessary. There must be no aristocracy of the crippled; malingering and valetudinarianism must not be stimulated and encouraged. It does not seem possible—at any rate, it did not seem possible to European theory and practice—to accomplish these results by ironclad rules and scales of benefits, in which individual idiosyncrasies are entirely neglected.

The peculiarity of the American methods of handling these cases

is just this, that we have assumed to be able to do what the European could not do; we thought we could solve or at least simplify this problem by a few legislative standards, and the appraisalment of these standards represents an important social duty of casualty statisticians and actuaries.

The most destructive feature of the American methods is the so-called dismemberment schedule, perhaps more accurately designated as the specific benefit schedule.

It is scarcely necessary before an audience of this character to explain at great length what this term means. The essential feature common to all the schedules is a definite amount of benefits for certain specified permanent injuries, namely losses of extremities and parts of extremities, and also other injuries, to be referred to presently.

Introduced at first in the first state act to stand the test of the courts, namely the New Jersey Act of 1911, the dismemberment schedule has acquired almost universal application. Of the thirty-three acts at present in force, only six—those of California, Kansas, New Hampshire, Washington, and West Virginia—contain at present no dismemberment schedule. As far as California is concerned, the statement may need to be modified, because such a schedule (though with certain important modifications) was established by administrative authority. It is pointed out that in several cases, the original act contained no dismemberment schedule, but that it was introduced during a subsequent revision of the act. This is used as an additional argument in favor of such schedule.

One distinct feature of such a schedule was already referred to. The character of the dismemberment determines the compensation. In one or two acts (Alaska and Wyoming) this amount is altogether uniform—in lump sums. In Oregon it is absolutely uniform, because the amount of periodical payment is uniform. But in the remaining twenty-four acts, or thereabouts, the dismemberment schedule has another uniform feature: though the injury is admittedly permanent, and by presumption the disability equally so (and in fact though some minor dismemberments do not necessarily result in any permanent loss of earning power, most laws speak of all dismemberments as cases of permanent disability) and furthermore the disability in most cases only partial, the basis of compensation just the reverse of what the conditions call for—the full compensation for a limited time.

Into the details of the various dismemberment schedules, I have no time to go now, nor is it necessary, since all casualty statisticians are familiar with them in a general way, and a detailed knowledge is almost impossible. Suffice it to say that there never has been any scientific study made to justify these specific valuations, and there is no harmony or reason in the different valuations made of the same injury by different states, nor of the proportions which the valuations of different injuries bear to each other in the different acts. Everything is sheer guesswork, or rather the result of crude bargaining between the interests of the wageworkers demanding more, and the employing interests willing to give less.

But with all these numerous valuations, there remains the uniform principle—a limited benefit (often excessive at its weekly amount) for a permanent disability. At least subconsciously there must have been some theory underlying this unique method, discovered by New Jersey and adopted by almost all the other states. Of course, the student of the history of casualty insurance will recognize in this method the influence of personal accident and even workmen's collective insurance. But this historical explanation will hardly seem sufficient as a justification.

The theoretical basis of this method has been stated in the report of the U. S. Employees Liability and Workmen's Compensation Commission as the theory of adjustment or rehabilitation.

The theory claims that from every permanent partial disability, there is an eventual recovery (a statement, when literally taken, contradictory in terms, if not altogether nonsensical), or at least some readjustment, which makes the discontinuance of further compensation possible, and that the period of readjustment varies with the severity of the injury. The specific dismemberment schedule is intended to cover this period of readjustment.

Of this plausible theory, there is only one criticism to offer—that it isn't so. Of course, it is obvious that in many cases, especially of minor dismemberments, such an adjustment will sooner or later take place, with complete re-establishment of full earning capacity. But it is equally obvious—and our compensation acts are almost all guilty in not recognizing it—that in grave dismemberments, or any grave injuries, this rehabilitation never takes place, and the readjustment is from comparative comfort to a lower standard, to destitution or to pauperism and dependency—the sort of readjustment that it is the direct function of compensation acts to prevent.

And though the denial of the underlying theory is sufficient criticism, the American method of compensating dismemberments is equally faulty in other directions.

Assuming for a moment that readjustment or rehabilitation takes place, what reason is there to believe that it will take place in all cases with equal rapidity, depending only upon the surgical description of the injury? The answer is—no reason at all.

In European statistics we have a large volume of experience to base our conclusions upon. It is sufficient to glance at the detailed Austrian data of nature of injury and their degrees of disability as digested in the 24th Annual Report of the U. S. Commissioner of Labor. The data have often been criticized on the plea that the awards in Austria are very much more liberal than awards for similar injuries in this country are likely to be. That may well be so, whether the criticism implied in this comparison should properly be directed against Austria or our own country. What is clearly indicated by the study of those figures is the wide margin of variation in the economic results of the same surgical injury, or rather of injuries described in the same surgical terms. Not only that, but the effect of at least one factor, that of age, is statistically demonstrated beyond any shadow of doubt, while as to the strong effect of the factor of occupation there can be no doubt in the mind of any man at all familiar with productive processes.

The disregard of these factors in our dismemberment schedules would be sufficient to condemn them even if their essential principle had not been in entire variance with the facts in the case.

But even within the limits of the same age and occupation, a definite margin of fluctuations should have been provided for. After all, the classification of the dismemberment has in view only the ultimate surgical result of the injury, but not its course, character and gravity. An arm amputation may heal in two weeks, another may take months and months in healing, meanwhile creating total temporary disability. In almost every case, the partial disability resulting from dismemberment must be preceded by some period of total disability. In some cases, however, this preliminary period may be so prolonged as to encroach in a substantial way upon the so-called period of adaptation or rehabilitation, and leave very little compensation for the partial disability itself.

Again the situation is so obvious that its disregard in most acts is another evidence of the glaring incompetency of our compensa-

tion legislation. Only in five acts (New Jersey, Illinois, Massachusetts, Rhode Island, and Texas) is a special provision made for additional benefits for the total temporary disability preceding the partial disability. In fact, it is not difficult to conceive the situation when because of the existence of complication, such as infection, even the total disability period may exceed the period of compensation established in the law; and in such cases the "easy and convenient" dismemberment schedule simply serves as a limitation of the benefits; for only in two states (Colorado and Wisconsin) do we find the specific provision that total temporary disability payments may continue beyond the limit established in the law.*

Finally the Louisiana Act goes the limit, as it were, because the dismemberment schedule is simply the maximum limit of compensation, which stops as soon as the injured workman returns to work, no matter at what wage.

Of course, all these statements do not apply to Massachusetts, Rhode Island, and Texas, where the small dismemberment benefit schedule is simply a bonus payable in addition to compensation for total or partial disability.

In explanation of these peculiar methods of compensation, ignorance of compensation experience must be largely held accountable, yet ignorance is not the entire explanation. Back of it is the desire not so much for easy and simple methods, as for low cost of compensation. An actuarial comparison will readily demonstrate that the payment of full benefits for a limited number of weeks amounts to very much less than a life pension for the proportionate amount of compensation. But even if it were agreed that the cost must not be increased beyond the present standards, the wasteful, incompetent, socially undesirable way of paying the limited amount is altogether indefensible. Since the weekly amount of compensation remains the same, though the disability is partial only, the situation must necessarily arise when the combined benefit and earning equal or exceed the full normal earnings of the time preceding the injury. What social justification is there for the creation of these temporary artificial standards, which in one certain day must be suddenly reduced to the subnormal level based only upon impaired earning capacity? Surely a wage worker who has lost one-half his earning capacity would be much better off, if for

* This seems to be also true in California, though the language of the law is not decisive.

400 weeks he was in receipt of 83 per cent. of his normal earnings than if he gets 116 per cent. of his earnings for 200 weeks, and then only 50 per cent. for the 200 weeks following.

There is thus very little justice, equity, economy or even ordinary common sense in the most lauded dismemberment schedules. How about other cases of permanent partial disability? Many of the members of the Society may remember the acrimonious discussions as to the proportionate number of these so-called "other" permanent cases, and the criticisms to which the Standard Accident Table was and is still being subjected for its assumption of 2,442 out of 100,000 accidents. I shall not carry the discussion over into this meeting. Whether the figure in the table will hold, I have no means of being certain. I am certain, however, of the utter fallacy of those statistics which have emanated from many sources and which seem to claim that no cases of permanent partial disability except dismemberment occur. Out of 257 different kinds of permanent injuries listed in the California schedule, only 105 are cases of dismemberment. Surely the other 152 varieties are not limited to California soil. We shall presently see the reason for the disappearance of all injuries of this kind from the statistical returns of other states.

In almost all the acts, special reference is made to those other cases of permanent partial disability, and in some, also, temporary partial disability. It may be stated in passing that this careful distinction which is found in some acts between temporary and permanent disability is not only misleading but also naïve, considering that though the injury may be permanent, the compensation is only temporary and often the time limit for compensation is the same whether the injury is permanent or temporary. In fact in most acts, though special reference is made of permanent partial and temporary partial disability the provisions for both are identical, and the duplication of the language is evidence that the language and form of the European acts were followed, when the spirit was entirely disregarded.

But when the treatment of dismemberments (or specified injuries) is compared with the treatment of "other" permanent partial disability cases, a very curious contrast is obtained. For this latter group the European principle of reduced or partial weekly benefits is preserved. It is true that with the exception of California, West Virginia, and perhaps New York, and one or two other

acts, either time or money limits are placed upon the compensation for these cases, but outside of this peculiar American limitation (the motive behind which is so simple that it does not need any elucidation) European precedents are followed, at least in theory, or on paper.

Much as we prefer this method, as a more equitable one, it must be admitted that the distinction between the two groups of permanent disability cases, dismemberments and other cases, is a most illogical one. Why then two entirely different principles in application to cases so near each other? If there is anything in the theory of readjustment and rehabilitation, why should its application be limited to dismemberments only? As a matter of common sense, the distinction should perhaps have been the other way: for an unhealed fracture may eventually unite, and a stiff finger may through expert treatment become somewhat more pliable, but nothing is so sure as that a lost arm or leg will never grow again.

As a matter of fact, the distinction exists in theory a good deal more than in practice. The dismemberment schedule is a misnomer, because in many states many other injuries are covered by the same broad phraseology. As already stated, the usual dismemberment schedule covers loss of arms, hands, fingers, legs, feet, or toes, as well as loss of eyes. Most of the acts (16 or 17) also cover loss of vision, 8 acts also loss of hearing in both ears, 4 states even the loss of hearing in one ear. One or two states even cover the loss of nose and external ear, while Nebraska, Hawaii and Pennsylvania only include major dismemberments, and no loss of fingers or toes. But in addition two states (Massachusetts and Minnesota) make permanent loss of use of any member equivalent to its loss, and ten more states contain a similar formula limited to major injuries (loss of use of arms, hands, legs or feet), three more assert that permanent and complete paralysis is equivalent to loss, and two acts insist that ankylosis or contractures which make fingers more than useless (whatever that may mean) is equivalent to loss. Thus some 17 out of 27 acts have some "loss of use" provision, which materially affects the respective spheres of activity of the two systems of compensating for permanent partial disability.

This does not conclude the story of the encroachment of the dismemberment method upon the so-called "other" cases. When we study the provisions in regard to these other cases, we find the following striking situation:

1st. There are at least two acts (Alaska and U. S. Federal Employees Act) which absolutely fail to recognize any cases of permanent partial disability except dismemberments. How these cases will be adjudicated in Alaska, I do not undertake to say. Under the federal act the peculiar situation exists that some partial disabilities are compensated up to the full amount, while others are not compensated at all.

2d. There is another state with a very crude system of lump sum settlements—Washington.

3d. In several states (Iowa, New Jersey, Oregon, Wisconsin and Wyoming) there is an explicit provision directing that all these cases shall be compensated in proportion to dismemberment cases.

Of course, the theoretical basis of such methods is no stronger than that underlying the whole method of specific injuries. The duty which devolves upon administrative or judicial bodies in settling these cases under such a provision is very much different from the duty which European arbitration commissions must fulfill. It is one thing for persons expert in a trade to agree upon the degree of disability caused by a specific injury; and quite another to speculate upon the quantitative relationship between one injury and the other, especially if the injuries do not affect the extremities to which the enumerated specific injuries are usually limited. The result is still more guesswork, and even the opportunities to gain the necessary knowledge from experience have been thrown away.

This method of assimilating all permanent partial disabilities to "fractional dismemberments," as it has been called by some, is specifically prescribed in a few states only, enumerated above. But there is strong reason to believe that the extension of this method is much wider than the mere language of various acts would seem to indicate. Few states as yet publish any compensation statistics, and even from the public reports so far available, little information as to this point can be obtained. But so far as my personal knowledge goes, I have strong reason to think that even in New York, all partial permanent disability cases, not dismemberments are compensated for either as dismemberments (under the "loss of use" clause) or in proportion to dismemberments, as if the New York Act contained a clause similar to that in New Jersey. As a matter of fact, there is no such clause in the New York Act, and there is little justification in the English language for interpreting "loss of

use" as meaning "impairment of usefulness," and one cannot escape the suspicion that on appeal to the higher courts, this method of compensating permanent partial disability may be declared contrary to the spirit of the law.

The objections used against this application of the New Jersey provision to the New York Act are usually met by the argument, that if this had not been done, there would result the anomalous situation of the lighter permanent injuries (not dismemberments) receiving more compensation than the serious dismemberments. That such a situation would appear illogical may be readily admitted, but unfortunately this is just the situation created by the law, and one may question the wisdom of modifying or destroying explicit requirements of the law by administrative action.

Since compensation insurance, and therefore adjustment of compensations claims, is not limited by state laws, it is quite likely that the same practice has developed in other states as well, and when in the adjustment of these permanent partial disabilities, no such assimilation to dismemberments takes place, a common method is a lump sum settlement—not an actuarial commutation of future payments due under the law, but a settlement by mutual agreement, approved (in those states where such approval is required) by the existing administrative board, or commission. If the legal requirements outlined above are often a serious reflection upon the quality of our law-making, the encouragement of lump sum settlements, by many if not most of our accident boards, is no less distressing. The social efficiency of these all too frequent lump sum settlements is a matter of grave doubt and would require careful inquiry.

As against these general types of compensating permanent partial disabilities, two distinct types require special consideration; the California system (followed to some extent in the new West Virginia act) and the Massachusetts system, the latter of which has also been adopted in Rhode Island and Texas. These two systems have also been frequently discussed and compared and both have their enthusiastic supporters.

The California method has already been described in a paper read before this Society by Mr. Michelbacher.* The remarks directed against the California method need not be taken in a spirit of criti-

* Vol. I, page 257 of the *Proceedings*.

cism of that paper, in which the principles of the well-known California Act have been clearly and accurately described.

The California Act ostensibly contains no dismemberment, or specific injury schedule. There is, therefore, absent that very illogical method of drawing an artificial distinction between one class of injury and another. In addition the California Act is superior to the other acts in two distinct points; it clearly requires that due consideration be given to the age and occupation of the injured, in determining the degree of permanent disability caused by any injury. Finally it adopts the rehabilitation theory within certain limits only, establishing light pensions for permanent disabilities over 70 per cent. While all this must be quoted to the credit of the California Act, it nevertheless fails to meet the requirements of a scientific method of compensating these cases. While a good deal is said of the degree of disabilities in percentages, nevertheless the compensation is granted, not in the weekly amount, but in duration of the full weekly benefit. At least for injuries up to 70 per cent., by a purely arbitrary standard, four weeks compensation is allowed for each degree of disability. The same childish faith in the universal truth of the rehabilitation theory is evident, and by implication all permanent disabilities under 70 per cent. are announced not to be permanent at all.

It is true that at certain points the rehabilitation theory is abandoned. If the disability is appraised to exceed 70 per cent. a life pension is granted. But the amount of it is ridiculously small. After the first 240 weeks the pension is 40 per cent. if the permanent disability is total, decreasing by 1 per cent. for every degree of disability down to 70 per cent., when the pension is only 10 per cent. of the earnings.

What is the theory underlying these quantities? Why should the compensation suddenly decrease from 65 per cent. to anywhere between 10 per cent. and 40 per cent. in these cases, and the total income from a possible 95 per cent. (65 per cent. compensation plus 30 per cent. earned) to only 40 per cent. (since the pension is made equal to 40 per cent. minus per cent. of remaining earning capacity)? Here another singular hypothesis is encountered, a theory actuarially ingenious, but socially often without any foundation in fact. It is assumed first that a married employee requires for his own personal use only 40 per cent. of his earnings, and his family the remaining 60 per cent., and secondly, that within the 240 weeks

the family may be sufficiently rehabilitated so as not to require any additional social provision. The 240 weeks is assumed to be sufficient for such rehabilitation simply because this is the standard of compensation for fatal injuries. The California legislators may still need to be taught that two wrongs do not make a right. As a matter of fact in quite a number of states, the period of compensation for fatal injuries has been extended to 400 or 500 weeks; life pensions to widows and pensions to children up to age 18 is the standard in New York. With one or two exceptions the California limit of 240 weeks for fatal injuries is the lowest in the country, and just because it happens to be so low is no evidence that family rehabilitation, for some climatic reason, takes place quicker in California than anywhere else in the United States.

Waiving aside this more than doubtful theory, the fact remains that after the expiration of 240 weeks, or only a little over $4\frac{1}{2}$ years the workman, totally permanently injured, received 40 per cent. of compensation, and workmen suffering an injury of 70 to 90 per cent., from 10 to 30 per cent. of their wages, or 14.3 to 33.3 per cent. of the loss of their earning capacity.

All of this is, however, a criticism of the law and not of the the California or the Whitney schedule, which has already been frequently discussed by actuaries. Perhaps, it is as unnecessary, as it is impossible, to go into further careful consideration of this schedule, though the claims made for it rather invite criticism. The schedule aims to carry into effect the provisions of the act mainly as to effect of age and occupation. It is based partly upon much careful thought and study, partly upon certain fundamental assumptions as for instance that the effect of age is a simple arithmetical factor uniform for all ages. There is no way of checking either this fundamental assumption nor the other decisions of judgment, so that it is as difficult to attack them as to defend them. Of course, the entire schedule is somewhat misleading because it speaks of degree of disability when in reality weeks of compensation are meant, and thus a subterfuge is established, perhaps legally necessary, but a subterfuge nevertheless. If we say: this injury will permanently disable a man of 50 by about 50 per cent. but a man of 20 only 30 per cent., that is a statement which has a definite meaning. In Professor Whitney's schedule, these figures are meant to say that the man of 50 will rehabilitate himself from the result of this injury in 200 weeks, and a man of 20 in 120 weeks. That

may or may not be true, but it is a statement of an entirely different meaning. As a matter of fact, what the statement means in real life, and not in academic discussion, is something entirely different—it says: when receiving such an injury the man of 50 shall receive compensation for 200 weeks, and the man of 20 for 120 weeks.

Now the most important objection to the schedule is not the possible error in this or that specific assumption, but the underlying theory that it is possible and desirable to construct such automatic methods of appraisement, especially at this early stage of compensation experience. For it would seem far better that instead of mathematical assumptions, we had numerous observations of facts, instead of actuarial accuracy, some consideration for the idiosyncrasies of life. All schedules, not excluding the California one, remind me strongly of medical treatment by correspondence, or printed recipes in newspapers. Modern social thought has recognized that economic and social diseases, like bodily diseases, require individual treatment.

A striking contrast is presented by the Massachusetts, Rhode Island and Texas systems, and it is no mere coincidence that in a recent report of the Massachusetts Industrial Accident Board, a comparison between the Massachusetts and California systems was made. Of course, in recognizing the necessity of light pensions at least in severe permanent injuries, the California Act is superior to the Massachusetts Act. But outside of that, the Massachusetts type of act (with its imitations in Rhode Island and Texas) deserves the most serious study because of the clear recognition of the principle of partial disability and the necessity for partial compensation.

Of course, it will be recognized that in this brief analysis, only the written word of the law has been covered. The actual application of the law is an entirely different and much more difficult matter. Some idea of the tendencies of actual administration may be obtained from decisions and awards, already available for several states. But after all, the result of such study must be far from decisive—no more than a tendency can be observed. Only through careful statistical reports giving full information as to the manner of claim settlements and amounts of awards, can a complete picture be obtained. And unfortunately such reports are still largely lacking. Furthermore, a critical estimate of such awards and of the benefit scales upon which they are based (or pre-

sumed to be based) will only be feasible if, in addition to awards, the physical conditions underlying them will also be studied statistically. In this direction lies a new opportunity for the compensation actuary and accident statistician; not only for rate purposes must he continue to pursue his investigations, but also for the acid testing of the efficacy of our compensation legislation in the light of social results. Specifically, this opportunity presents itself to actuaries and statisticians connected with supervisory government institutions. The technical outfit of the accident statistician is gradually being perfected. In the skillful and honest hands of the impartial student of social statistics, this outfit may become an instrument of great social weal.

COST ACCOUNTING IN CASUALTY INSURANCE.

BY

CLAUDE E. SCATTERGOOD.

The necessity of some system of cost accounting in casualty insurance catches the attention of all who look even superficially at the accounting and statistical exhibits of organizations in the field of casualty science. No study is necessary to make this need impressive, a quick glance, a bird's-eye view portrays the condition.

Let any one take the detailed annual statements of casualty companies entered in the Insurance Commissioners' Convention Edition statement forms, which are uniform for all points that are common to all states, and make a study of them. Take the statements of the various companies as the writer has done for years and analyze them all in the same manner, finding the ratios of expenses not allocated to lines of business to total cash received for premiums for all lines of business, and the ratios of expenses and losses which are given for lines of business separately to the cash received for premiums for the respective lines, and then compare the results for the various companies and see how widely at variance they are. Some variations must be expected, but those shown differ beyond any reconciliation as to a uniform manner of accounting.

As a particular case in point, work out the ratios of claim expenses paid to losses paid and also to cash received for premiums in the accident and health lines, and observe how greatly they vary for different companies. The amounts spent for claim expenses of the accident and health lines appear ridiculously small for some companies, and the common explanation is that such companies probably include them or most of them under the expense division "Salaries, fees and all other compensation of officers, directors, trustees, and home office employees," upon the interpretation that claim expenses at the home office are home office salary expenses, and despite the warning note in the blank that claim expense "embraces all expenses attending the adjustment of claims, whether

for lawyers, experts, or adjusters, *including home office supervision and clerical work, rents, and generally all expenses in and about the settlement of claims and the defense of actions relating thereto.*"

Another practice of some companies appears to have been the inclusion of first-aid payments under liability policies with the claim expenses concerned with them.

The peculiar statement of another company comes to mind where one year the total claim expenses in connection with liability and compensation business shown as disbursements in the revenue account was less than the unallocated claim expenses stated in connection with the calculation of the liability and compensation loss reserve in accordance with Schedule P. To those unfamiliar with this item, the case was one where the whole was smaller than one of its parts.

Another question arises with regard to "advertising" and "printing and stationery." Do all companies charge the expense of circulars, etc., to the same expense division, be it "advertising" or "printing and stationery"?

Last spring a Committee of the Insurance Commissioners and the Committee on Blanks of the International Association of Casualty and Surety Underwriters met in Hartford, Connecticut, and studied proposed revisions of the disbursement sheet of the Insurance Commissioners' Convention blank with the idea of recasting it so that the financial operations of the companies in connection therewith would by means of such revision and in connection with explanations of what should be included in the various subdivisions, be more accurately shown in a way approximating uniformity for all companies reporting thereon. The deliberations of these two committees brought to light broad divergences in the interpretation of the manner of reporting.

In the above paragraphs the endeavor has been made to point out some of the inconsistencies resulting from the reporting of the companies on a form of statement designed to produce uniformity. We now come to the important consideration of comparing the results of compensation business as carried on by stock companies, mutual companies and state funds; and self insurers can gain much by comparing their results if measured by the same standards as it will be sought to show the other three should be measured by.

Stock and mutual companies and state funds for the purpose of comparison as to efficiency should show the results of their opera-

tions in a uniform manner, and as a further safeguard should be audited by the same disinterested auditors. The public especially, if its money is spent by a state fund has the indisputable right to know if its administrators are as efficient as those connected with stock and mutual companies, and how can the public judge if the measures are not the same? We have in mind one state fund whose expenses are paid by taxation and whose operations are a part of the work of an industrial commission. The expenses of this industrial commission are divided into groups, four of which are "executive," "state fund," "statistical," and "inspection." Not one item of information is shown as to the method of accounting. How much, if any of the expenses of executives, statistical, or inspection staffs are charged to the state fund? Because stock and mutual companies have executive, statistical and inspection expenses, this particular state fund must have them, but the public can not tell whether any or none of such expenses are charged against it. Because this particular illustration is so glaring, it becomes impressive when we consider the situation of stock and mutual companies and state funds *actually accounting* for expenses but in diverse manners.

Take the consideration of medical payments and claim expenses. Medical payments should be charged to losses and claim adjustments to expenses. It is to the advantage of an insurance carrier to appear before the public as paying out as much of its premiums as possible for losses and as little as possible for claim expenses, and right here comes the question of accounting method. It is perhaps unnecessary to say that claims must be adjusted, must be supervised; money is not paid out on uninvestigated conditions. One class of insurance carriers has men to investigate and other men to cure. Another class of carriers has the same men who investigate and also cure; that is to say, they are all physicians. Does the second class of carriers free itself of claim expenses because its physicians do the investigation *and* adjusting? It would seem that it should not, because, though physicians are employed, they perform *two classes* of work—medical and claim adjusting. It is not intended that the ratio of claim expenses to losses should be approximately the same for the two classes of carriers, but it is contended that the cost to the insurance carriers of physicians who also adjust claims should be divided between losses and claim expenses. Otherwise, how can a fair basis of judgment be ob-

tained: for one could not think of proposing that all companies should employ physicians as claim men.

In this connection it is gratifying to note that our Society has a Committee on Terms, Definitions and Symbols, and one on Workmen's Compensation Statistics, the results of whose labors will set standards by which all parties interested ought to measure their operations.

We shall now put aside the consideration of uniformity of reporting as between insurance carriers and take up the proposition of a company transacting multiple lines of insurance which desires, for its own purposes, enlightenment, and guidance, to ascertain as close an approximation as possible to the true cost of conducting *each* of its lines: a company which *does care to know* whether one line is paying a part of the losses and expenses of another line or not, and which, knowing that the acquisition expense of its compensation and liability lines is limited to certain percentages of the premiums, desires to know that it is keeping within the limits.

Right here it should be noted that the proper pro-rating of expenses is not by premium volume. Other methods should be employed, amongst which is the number of transactions handled. If we have \$100,000 of accident premiums and \$100,000 of automobile liability premiums, the premium volume method gives 50 per cent. of expense to each. If, however, for illustration, the average accident premium is \$40 and the average automobile liability premium is \$100, we have 2,500 accident transactions and 1,000 automobile liability transactions, and the pro-rates are 71.43 per cent. to accident and 28.57 per cent. to automobile liability. If it be argued that more time is spent on an automobile liability transaction, let us give it a weight and for illustration let it be 2, and we have 2,500 accident and 2,000 automobile transactions, giving 55.56 per cent. of the expense to accident and 44.44 per cent. to automobile liability. The consideration here is the proper calculation of the weight to be used.

The writer some time ago invented and installed a system for the Fidelity and Casualty Company of New York by whom he is employed, which is in actual operation and forms the basis for this discussion. It, of course, is not the only system of cost accounting, for casualty insurance; it may not be the best system, but it is *a* system. Our consideration of it in this paper may be likened to a silhouette, the form within the outline being capable of various

treatment, with presumably an advantageous variation of the outline itself.

The expenses of a casualty insurance company may be divided into the following two general classifications:

1. Home Office Expense.
2. Field Expense.

Each of these general divisions of expense may be subdivided into:

- (a) Acquisition or Business Getting.
- (b) Underwriting.
- (c) Inspection.
- (d) Claim.

A further item of "Booking" may be assigned to "Home Office Expense."

These subdivisions may be again subdivided *ad libitum* consistent with practicability, but as this paper is a study of *method*, further analysis herein is unnecessary.

It will not be necessary to define these expense classifications except to state that "Booking" is the recording, but not the statistical analysis of the transactions upon the home office records of the company, the same as would be done for any business organization.

Let us first consider the Business-Getting Expense in the Field. This is composed of commissions which can be charged direct to lines, and other expenses such as rent, stationery, traveling, etc., which cannot be so charged. For the pro-rating of these other expenses, count the number of transactions on the books of each branch office and let the relation of the number of transactions for each line of business transacted to the total transactions for all lines be the ratio which when applied to the general expense of the office will give the portions of such expense applicable to the various lines of business. Of course this method may be modified by taking out of this general expense item such amounts as can be charged direct to lines, and it may be further modified by assigning weights to the transactions of the various lines as it may be demonstrated that they may consume more or less time of the branch office in attending to them. The idea is to consider the transactions on the records of a branch office as symbols of the time spent by the office on the different lines of business. My company does not count endorsement entries other than those for property-damage

and collision, which, of course, fall into the business divisions of "automobile property-damage," "automobile collision," etc.; neither do we count entries made by reason of payroll audits on liability and compensation policies; it is the original entry whether for new business or renewals that is considered, and the payroll audit is simply work done in connection with the policy evidenced by the original entry. The Fidelity and Casualty Company of New York considers all the expenses of a business-getting office as business-getting expense with the exception that a part of the salaries of men concerned with the acquisition of plate glass business who also help in adjusting the claims of this line are charged to "plate glass claim expense": and part of the salaries of our metropolitan office are charged to "Booking," because by reason of proximity to the home office the recording of the business in the metropolitan office saves "Booking," and an adjustment is made between "Business Getting" and "Booking" as respects this kind of work. Our inspectors are paid from the home office, and hence their salaries and expenses are in no wise connected with the work of a branch office.

For the other items of expense, both in the home office and in the field, the following plan is set forth. If the system of pro-rates is designed for immediate use, use payroll of some period (we recommend six months) immediately preceding the period for which pro-rates are sought. If pro-rates are to be used retroactively, measure the work of the year to be analyzed. In either case the following method is submitted.

For each field claim office and for each department of the home office, place the names of all employees,—officers, managers and clerks, both permanent and temporary, who have been employed for all or part of the time period used as a basis, in a vertical column, and against the name of each employee place the actual amount he received in salary during that period. To the right of these two columns place five other columns entitled "Business Getting," "Underwriting," "Inspection," "Booking," and "Claim," and divide each of these five columns into separate subcolumns each one bearing the name of a line of business transacted by the company.

Send these blanks when so prepared to the manager of each field claim office and of each home office department and request him to put against each employee's name in the various subcolumns ratios or per cents (not money-amounts), showing the percentage of the

total time of that employee, which according to his careful judgment the employee spent, in the time-period considered, on the various divisions of expense by lines of business. Of course, the total of these ratios or per cents in each case must equal unity. When these per cents have all been entered, apply them against the salary received by each employee and place the products in the same columns.

Then for *each* field claim office and for *each* home office department, sum up the total salaries paid therein, and the totals appearing in each column showing expense subdivisions, and divide the total for each expense subdivision by the total salaries paid and thus obtain a new set of pro-rates for each field claim office and home office department considered as a whole. Assuming that this pro-rate of *salaries* upon basis of time spent on various subdivisions of expense is an indication of the *expenses other than salaries* of a field claim office or home office department, after charging such items of expense as can be charged direct to an expense subdivision, pro-rate the remainder of expenses by means of the final pro-rate.

Of course the one assigning the individual employee's pro-rates may use data to guide him in the assignment, such as items handled as evidenced by count of cards, claim files, applications, etc., in the various lines of business.

This method, when the pro-rates of a department are applied direct to the total salaries of a department, avoids discrepancies due to the changing of work of an employee, or his transfer from one department to another.

Let us now take the total salaries paid in each home office department and add them all together, and then take the analyses of salaries of all departments (the money-amounts) and add them all together, adding like subdivisions to like. Divide this new total of all salaries paid into the total for expense divisions and we have another set of pro-rates which are to be applied to all salaries of men whose work is not within departments, which is general, such as executive officers, men in the supply department, mail department, etc., and these pro-rates too may be applied to general expenses, which cannot be allocated direct to expense subdivisions.

It should be noted that where a *department* incurs an expense the *department's* pro-rates should be used, but where an expense is incurred for underwriting or claim, etc., generally, pro-rates based upon *division of expense*, no matter in what particular department

incurred, should be employed. As an illustration, in my company liability and compensation underwriting pro-rates *in toto* come from four sources: liability and compensation underwriting department, statistical department, stenographic department, and salaries which are general.

The important thing is to get the items as a basis for pro-rates, and with them before you, their uses in combination are countless, but the basis is uniform and as correct as it appears practicably possible to obtain.

It will, of course, be appreciated that an exhaustive description of the above method could not be made within the limits of this paper. A method has been described which it is believed is founded on good reasoning and capable of being actually employed. It is a method whose use is not prohibitive by reason of expense in connection with it, an important consideration. It may have its faults, but it is believed that trustworthy results are shown by its use. It avoids general ideas and conclusions, and the pro-rates obtained by this approximation to actual conditions as measured by the men in closest contact with the departments they manage produce results which ought to be very close to the cost of conducting the business of each line. By furnishing the various departments of a company with their respective pro-rates, and also with pro-rates for expenses irrespective of departments but according to "expense divisions" it becomes possible to immediately pro-rate every expense item as it comes up for entry upon an "Analysis of Expense" book into which pro-rated amounts are entered as they are incurred or paid, which book if analyses are entered when money is paid may be kept in correct balance with the general cash books of the company. The pro-rating of every item as it comes up for entry in the "Analysis of Expense" book will involve a great deal of multiplication. In order to avoid this the device may be adopted of collecting all items which are to be pro-rated in the same manner in a subsidiary memorandum account, and then when a sufficient number have accumulated, sum them and pro-rate the total accumulated.

We could, of course, have discussed this pro-rating system by means of algebraic symbols, but thought that a more useful method would be an outline, as simply expressed as possible, in terms recognizable by any man connected with casualty insurance.

It should also be stated that some one man or committee should

be in charge of the entire system, so as to avoid conflict of interpretation of expenses, which controlling authority should issue definitions of expense subdivisions to department managers and to whom all should go for decisions on doubtful points. This controlling authority should keep an index of its decisions so as to avoid divergences in method when questions arise from time to time which must be decided.

We recommend a four-place decimal system at least for the pro-rating of accumulated amounts or very large bills concerning many departments, and a two-place decimal system for small expenses in connection with incidental bills which continuously arise. The two-place system is recommended upon the sole ground of practicability.

Some of the forms used by the Fidelity and Casualty Company in connection with its pro-rating system are appended.

THE FIDELITY AND CASUALTY COMPANY OF NEW YORK

MEMORANDUM FOR CLASSIFYING EXPENSE CHARGES

Note:—This form should be filled out and attached to every requisition made on the Cashier's Office for a check covering expenses as distinguished from losses. If a general or a departmental apportionment covers the item, note the amount of the item or the amounts composing the item under the proper heading or headings opposite the department to be charged. If the item is a specific charge against any particular line or lines, note the amount or amounts opposite such lines under the proper heading or headings.

General Headings

Prorate	Underwriting	Claim	Business Getting R. M.	Business Getting G. A.	Business Getting H. O.	Booting	Inspection (Other than Med. or Claim)	General
Agency								
Accident								
Accounting								
S. B. & F. W.								
Bonding								
Burglary								
Claim								
General								
Inspection								
Liability								
Plate Glass								
Statistical								
Stenographic								
M & S %								
CHARGE								
Fidelity								
Surety								
Bank Burg.								
Safe Burg.								
Resd. Burg.								
Resd. Theft								
Store Burg.								
Robbery								
Plate Glass								
Steam-Boiler								
Fly-Wheel								
Work. Coll.								
Emp. Liab.								
Pub. Liab.								
Teams' Liab.								
Elevator								
O. & T. Liab.								
Automobile								
Drug Liab.								
Compensation								
Teams' P. D.								
Auto. P. D.								
Auto. Coll'n.								
Accident								
Instalment A								
Health								
Instalment H								
Phys. Liab.								
TOTALS								

Indicated by a check (✓) the proper expense subdivision.

EXPENSE SUBDIVISIONS

Commissions	Invest'ns.	Taxes and Fees.	Printing S. & S.	Int. Rev. Stamps
H. O. Salaries	Sundries	Legal Exp.	P'stge, T'phone.	Text & Reference
H. O. Traveling	Rents	Advertising	Expr. and T'gph.	Books.
U. C. & I. Bureaus	Exp. on R'l. Est.	Exch. & Coll. chgs.	Fur., Fix., incl'd g.	
Medical Fees	not taxes	Subscriptions	repairs	

THE FIDELITY AND CASUALTY COMPANY OF NEW YORK

SUPPLY DEPARTMENT MEMORANDUM FOR CLASSIFYING EXPENSE CHARGES

Attached to order No.....

Note:—This form must be filled out and attached to every order on the Supply Department for purchasing supplies not in stock. If a general or a departmental apportionment covers the item, note the division of the item in percentage under the proper heading or headings opposite the department to be charged. If the item is a specific charge against any particular line or lines, note the charge in percentage opposite such lines under the proper heading or headings.

General Headings

Prorate	Underwriting	Claim	Business Getting R. M.	Business Getting G. A.	Business Getting H. O.	Booking	Inspection (Other than Med. or Claim)	General
Agency.....								
Accident.....								
Accounting.....								
S. B. & F. W.....								
Bonding.....								
Burglary.....								
Claim.....								
General.....								
Inspection.....								
Liability.....								
Plate Glass.....								
Statistical.....								
Stenographic.....								
M & S %.....								
CHARGE								
Fidelity.....								
Surety.....								
Bank Burg.....								
Safe Burg.....								
Resd. Burg.....								
Resd. Theft.....								
Store Burg.....								
Robbery.....								
Plate Glass.....								
Steam-Boiler.....								
Fly-Wheel.....								
Work. Coll.....								
Emp. Liab.....								
Pub. Liab.....								
Teams' Liab.....								
Elevator.....								
O. & T. Liab.....								
Automobile.....								
Drug. Liab.....								
Compensation.....								
Teams' P. D.....								
Auto. P. D.....								
Auto. Coll'n.....								
Accident.....								
Instalment A.....								
Health.....								
Instalment H.....								
Phys. Liab.....								
TOTALS								

ORDER FOR Printing Stationery Supplies Furniture & Fixtures including repairs Publications

SCIENTIFIC METHODS OF COMPUTING COMPENSATION RATES.—I. M.
RUBINOW.

VOL. I, PAGE 10.

WRITTEN DISCUSSION.

MR. HARWOOD E. RYAN:

It is more than a year and a quarter since the paper under discussion was published in the first number of the *Proceedings*. The developments of compensation rate-making since then make it all the more interesting to review at this time. Dr. Rubinow has pointed out many of the difficulties encountered through the absence of statistics which are either extensive enough or which can be used in combination with other statistics. We are still a long way from that degree of completeness and uniformity which are essential to the solution of our most elementary problems. It would be unfair to belittle the part which has been played in the determination of basic rates for the various states by the method of differentials. The application of that method was made practical by the Rubinow Standard Accident Table. As the author himself points out, however, the system of law differentials cannot be carried much beyond the point of applying the Standard Table to the compensation benefits of a given state as a whole.

In theory there should be a similar table, showing the relative gravity of accidents for each of several classes of industry; otherwise there must be introduced into the calculation of differentials certain serious errors which cannot fail to have a disturbing effect upon rates so determined. For example, the manual of rates for Pennsylvania is based upon an average law differential of 1.02, comparison being made with the original Massachusetts act. The industries of Pennsylvania upon the whole are more hazardous than those of Massachusetts so that we may expect the experience to develop an actual differential which is considerably higher than 1.02. As a practical matter, however, there have been no reliable figures upon which to base a satisfactory modification of the average law differential so that the method applied was about the only one available. The main point is that the determination of rates for a new compensation state can be, and in practice has been, projected from existing rates covering a dissimilar act and the results, however crude, are doubtless far more accurate than could be obtained in any other way.

Dr. Rubinow will perhaps agree with the statement that in this country with the many different state systems of workmen's com-

pensation and the diversity of constructions adopted in administering the laws, the law differential will soon have to give way to experience in the determination of rates. Aside from the actual values which may be assigned to the various divisions of the Standard Accident Table, there is the further important element of accident distribution. We may mention, for example, the class of permanent partial disability cases (not dismemberment). The Standard Table shows 2,442 of these in each 100,000 accidents. Nothing like this relative number has appeared in any published American statistics, and I am informed that under the New York act the number of such cases is so small as to be altogether negligible. This may be due in part to error in the table. It is certainly due, to a large degree, to the disposition of American accident boards to award a specific benefit in those cases which in European countries are compensated according to degree of impaired earning capacity. The effect of this one factor alone is very great and we do not yet know how far in other respects the idiosyncrasies of American administration will cause more or less departure from the theoretic accident distribution indicated by the Rubinow Table. None of these practical considerations, however, reflect in any way upon the Table or upon its usefulness at a time when it was most urgently needed.

Dr. Rubinow states the formula used in calculating New York rates from Massachusetts data. It may not be amiss here to mention the basis reached on a subsequent occasion for the calculation of rates generally. It is now a matter of history that during September and October, 1915, there was held in New York City a conference of rating associations for the purpose of arriving at a uniform basis for determining manual rates which might be used, with suitable modifications, in Massachusetts, Pennsylvania, and wherever else a rate situation was impending. One of the committees of the conference was composed of actuaries, and was known as the Committee on Loadings and Differentials*—a self-explanatory title. In connection with the subject under discussion the principles laid down by this committee are of interest. It recognized the Standard Accident Table as the best means now available for the calculation of law differentials, at the same time recommending to this Society an early revision of accident statistics based upon American data. It then proceeded to define its own work in the following terms:

“This committee as finally constituted, was appointed to consider ‘the question of loadings and the question whether differentials are a proper subject to be treated by this Joint Conference.’ Consequently the first matter to be determined was the one of pro-

* The Committee consisted of Messrs. B. D. Flynn, A. H. Mowbray, C. E. Scattergood, I. M. Rubinow, S. B. Black, W. N. Magoun, and the writer, all Fellows of this Society.

cedure to be followed with reference to the general subject of differentials.

"In order to reach a definite understanding of what might be expected of the committee, the questions referred to it were subdivided as follows:

"Under the heading 'Differentials' were considered the following:

"Allowance for (1) differences in compensation acts governing benefits; (2) underestimate of outstanding losses; (3) increasing claim costs; (4) industrial diseases; (5) variation in rates due to merit rating; (6) differences in accident frequency.

"Under 'Loadings' were considered provisions for (1) expense; (2) profit; and (3) catastrophe hazard.

"This classification of the work cleared the way for the determination of the various questions involving differentials."

An important feature of the committee's work was in establishing the principle that expense loadings should be graded in accordance with the premium level of the several states, and in the analysis of expense items which shows clearly the distinction between the expenses of acquisition, administration, service and those imposed by law, such as taxes and license fees. The report of the committee on this subject is worth quoting:

"*Expense Loadings.*—In making provision for expense loading, the committee has deemed it to be its proper function to investigate the actual needs of the business as at present conducted, believing that any movement seeking to reduce expenses, however desirable, is an administrative question rather than an actuarial one.

"The committee finds after a careful study of the disbursements of representative companies, both as to their total workmen's compensation business and of such business as was reported to the states of New York, Massachusetts and Wisconsin, that the average expense ratio, based upon the transactions of the calendar year 1914, has been approximately 40 per cent. of the compensation premium income. An analysis of this ratio shows that it is made up of certain major divisions of expense as follows:

"Acquisition expense	17.5
General Administration expense	9.0
Including:	
Payroll audits	2.0
All other	7.0
Service expenses	11.0
Inspection and accident prevention	4.0
Investigation and adjustment of claims	7.0
Taxes, licenses, etc.	2.5
Total	40.0

"The above grouping of expenses is presented by the committee, in order to demonstrate that in considering the possibility of reducing the expense ratio, certain of the items such as 'Texas Licenses, etc.' are not susceptible to reduction by the companies, and that other items, such as 'Service Expenses,' should not be reduced, if efficiency will be thereby impaired. It is evident, therefore, that such reductions as may be effected, must be confined principally to 'Acquisition Expenses' and 'General Administration Expenses.'

"The committee finds further that the expenses naturally divide themselves into three general classes:

"(a) Such expense items as inspections and payroll audits do not vary with the gross premium rate, nor are they incurred as a percentage thereof.

"(b) Acquisition expense and taxes are incurred as a percentage of the gross premium rate, and vary directly therewith.

"(c) Items such as expenses of administration and claim adjustment, are properly chargeable in part in both of the foregoing ways.

"In order to give proper effect to these considerations, the committee undertook to determine what differences in loading should be recognized in the calculation of rates for the various compensation states. It was found impracticable to give full effect to the wide differences which theoretical exactitude would demand. It was felt to be necessary, however, to recognize that a flat loading for all states is improper and inequitable and certain groupings were adopted for the purpose of producing reasonable and practical results. Accordingly the committee recommends the following scale of expense loadings:

For States Having a Differential of	Percentage Loadings.	State Group.
"Less than 1.25	42½	1
1.25 to 1.49	40	2
1.50 to 1.74	37½	3
1.75 and over	35	4

"These results were applied to the probable relative premium income for 1916 and were found to reproduce approximately 40 per cent. loading on the average.

"Pursuant to this plan, the committee has assigned to their respective groups, twenty-three compensation states as shown in the list appended to this report as exhibit "C."

"*Loading for Profit.*—The question of a loading for profit was considered but it was thought to be unnecessary at this time to make specific provision therefor. The committee recognizes, however, that every legitimate business enterprise should take this factor into account and believes that in the future when rates have become more stable and are based upon more reliable experience data, it may be desirable to include a definite provision for profit.

"EXHIBIT 'C.'

"State Groupings.

Group I., Loading 42½%.	Group II., Loading 40%.	Group III., Loading 37½%.	Group IV., Loading 35%.
Colorado	Connecticut	California	New York
Indiana	Illinois	Massachusetts	
Iowa	Maryland	Ohio	
Kansas		West Virginia	
Louisiana		Wisconsin	
Maine			
Michigan			
Minnesota			
New Jersey			
Oklahoma			
Pennsylvania			
Rhode Island			
Vermont			

"*Loading for Catastrophe.*—In studying catastrophe experience, the committee met with considerable difficulty in finding reliable statistics upon which to prognosticate future cost. It decided, however, to make a conservative estimate which would provide for probable catastrophes upon an annual basis, even though the occurrence of an annual catastrophe, taking one year with another, is not to be expected.

"In order to limit the problem of measuring the catastrophe hazard, the committee made a study of certain serious accidents in the United States covering the years 1892 to 1913 inclusive. Appropriate values were assigned to each fatal and to each non-fatal accident. The total loss cost thus determined was used as the basis for an outside estimate. The committee concluded that such a loading should be provided for as would produce annually in the state of Massachusetts \$40,000 net after deducting expenses and in New York about \$200,000 annually. The committee believes that the fairest practical loading for catastrophe purposes is a flat loading for all classifications of a fixed amount per \$100 payroll. It is assumed that the basic pure premium will provide for an inherent catastrophe hazard in particular classifications such as, for example, coal mines.

"With these considerations in mind, the committee desires to report that a loading of 2 cents per \$100 payroll should be added to the gross premium of all classifications in New York and that a loading of 1 cent per \$100 be likewise provided for other states.

The trend of compensation rate-making in the direction of more scientific treatment is significantly shown by the very fact that the conference saw fit to provide for such a committee, and, further, in the nature of the conclusions reached by it. That there is much

more still to be accomplished is indicated by the final paragraph of the report which is indirectly an appeal to the members of this Society to do their part in promoting the development of proper statistical material for future use in practical rate-making:

"The committee has been guided by a desire to recognize *in principle* the essential considerations which are encountered in the process of constructing proper rates upon a foundation of pure premium results. It does not, however, recommend that all of these considerations be given expression as definite factors at the present time. We have been somewhat handicapped in our work by the absence of proper statistics which would have enabled us to do this, but it is believed that the results obtained are not seriously impaired thereby and that our study will lead to the development of such information for future use."

Next to the statistical foundation for future rates comes the treatment to which such data must be subjected before it can be utilized. Dr. Rubinow has mentioned some of the difficulties which spring from inadequate exposure data. I know it has been customary to discount the value of small statistical volume and we have acquired a certain habit of mind which looks askance upon payrolls that are much under three or four millions of dollars excepting perhaps in the industries of extremely high accident frequency and gravity. I believe we have put too much stress on the effect of serious accidents upon small exposures without realizing that chance has a way of operating unmathematically and at times very waywardly. For this reason the more serious losses should be related, not to individual classifications, but to large groups thereof.

Dr. Rubinow, in the paper under discussion, makes the same suggestion and in the *Proceedings*, Vol. II, pp. 124 et seq. Mr. A. H. Mowbray develops a method for grouping the data of small classifications so that more reliable pure premiums can be obtained. Mr. Mowbray's method contemplates the grouping of data to enlarge the exposure. It then redistributes the actual losses in proportion to relativity of class hazard. The weakness of the method suggested seems to lie in the absence of reliable factors of relativity. Given time enough and hence exposure enough, the pure premiums would furnish these factors. By that time, however, the necessity for grouping would have vanished and the indicated would be the true loss cost. We must therefore seek further in the attempt to smooth out the experience indications. I have in mind in a crude way which is not in shape to present at this time, a method which employs the principle of deductible average. The same principle has been put forward recently as a possible solution to the rating of individual risks with reference to their own experience. If the idea can be utilized in that manner there would seem to be less difficulty in the way of applying it to class experience and to group experience.

Briefly, the point is that the pure premium for workmen's compensation insurance is composed of two elements which can be

readily differentiated. The first is the cost of medical aid and of minor disability losses. The second is the cost of fatal and major disability losses. The occurrence of a loss of the first kind is of little consequence and causes no financial shock to a group or to a class or to an individual employer of moderate means. On the other hand, a loss of the second kind does cause just such a shock and since it is the function of insurance to distribute loss, to absorb shock, it is subversive of its true purpose to charge serious losses against small classes, just as it is unjust to throw such a burden upon individual risks. What should be done is to analyze the more serious losses as to their cause and to determine two main considerations. First, whether the loss was attributable at all to industry, and, second, to which particular group of industry it is chargeable. Occasionally there may be a serious loss which can only occur in connection with a given industry and which the class pure premium should reflect. The line between the class and the group will not be easy to discover or maintain, so that it were best not to carry the process too far nor to attempt to differentiate in this manner other than the losses of greatest severity. Such a method of treating experience data would assign automatically all ordinary or non-serious accidents to industrial classification. The occasional, serious loss would then be scrutinized and assigned on judgment to the classification, group, division or schedule or to the entire payroll exposure, as might seem just and proper to the committee in charge. Relativity of hazard as indicated by the pure loss cost of non-serious accidents may serve as a guide in spreading over the entire number of classifications the serious losses.

ORAL DISCUSSION.

MR. CARL M. HANSEN: May I ask Mr. Ryan what data the Conference had before it which would lead them to believe that there was any foundation for the difference in accident frequency by states in the same classification?

MR. HARWOOD E. RYAN: As a matter of fact, there was nothing at all, so the committee felt it was better to recognize accident frequency in principle only, and not to recommend any factor for use in present rate-making. A member of the committee submitted certain data based upon liability experience, but it had not been analyzed by industrial classifications, and we did not feel that it was suitable for use in our study, especially since the time was growing short.

MR. HANSEN: It was not used?

MR. RYAN: No; accident frequency was simply recognized in principle.

MR. JOSEPH H. WOODWARD: These various discussions all seem to revert back, at one time or another, to the question of cases of permanent partial disability, not dismemberment. I notice that

Mr. Ryan has just referred to this point in discussing Doctor Rubinow's paper. My impression of the disposition of these cases in this country—or in this state, rather—is that they are disposed of in one of three ways:

First: Some of them have received awards as cases of dismemberment. Doctor Rubinow is apparently of the opinion that most of them are treated as cases of dismemberment, but I am not sure that this is so.

Second, there are a number of cases that are continued along as temporary total cases after the time when the injured claimant has really recovered a part of his earning capacity. If he is not able to return to his old work even though he may be physically able to do something else, I think there is a disposition to award him full compensation temporarily. Of course, it may be said that he can do something else—that he can get a job as a watchman, or something of that sort; but as I heard a claim adjuster expressing it the other day, "the watchmen's jobs were all gone long ago."

Finally, there is quite a disposition, I think, to dispose of these cases by means of a lump sum settlement by way of compromise. I believe it will be found that a very considerable number are settled in that way, and probably those cases would get into the statistics as temporary total disabilities.

I think it would be of great value if somebody would take the trouble to investigate a large number of settlements and select those concrete cases where the actual facts, as developed by the claim papers, indicated that there was a physical condition of permanent partial disability, not due to dismemberment, and then find out how those cases were actually disposed of by the Commission or Accident Board, and tabulate those results. It is only by some such means as that, it seems to me, that we can definitely settle this question.

MR. G. F. MICHELbacher: Out in California we endeavored to rate all the permanent partial disability cases reported to the Commission under our schedule, and I think a bulletin to be issued shortly will contain a lot of information which will help to clear up this point.

MR. I. M. RUBINOW: I really meant to rise in order to ask a question in regard to these permanent total disability cases. Of course, my standard accident table was an effort to indicate the physical facts rather than the various vagaries of American accident boards, and certainly I could not tell what every industrial accident board, with its politics and everything else, was going to do. I thought I could foretell more or less accurately the physical facts. But I recognize that when we are dealing with permanent partial disability we are dealing with something more than physical facts. It is a physical fact with judgment added. From the claim papers it should be possible to separate the physical facts from the judgment added to it.

I recognize that in a great many permanent injuries it is hard to tell. A permanent injury is one thing, and a permanent disability is another thing. In regard to the types of settlement mentioned by Mr. Woodward, I really don't know whether it would be possible for the industrial commission to continue paying benefits under total temporary when the man had actually returned to work?

MR. WOODWARD: No. But if he has returned to work, he has almost invariably returned at his full wages.

MR. RUBINOW: That is a condition of affairs peculiar to America. I don't see how a man could get back to work with a stiff arm any more than he could get back to work with a lost arm.

I don't think that I am disclosing any confidential information when I tell you that Doctor Hatch is doing just the thing that Mr. Woodward suggested. He is analyzing twenty-five thousand cases. He has found, I am informed, a great many cases which he says he doesn't know what he is going to do with in the statistical analysis.

In the case of lump sum settlements, I think if a man returns to work and gets a lump sum settlement, the statistics in that case should certainly be very carefully scrutinized. I should be very suspicious when a lump sum settlement was made. I don't understand under what conditions a casualty company would be justified in paying a lump sum unless it is a suspected permanent partial disability.

Then, another thing is the matter of the dismemberments which you have mentioned, Mr. Woodward. Are they dismemberments in all cases, or are they dismemberment awards.

MR. WOODWARD: They include either the loss of a member or the loss of the use of it.

MR. RUBINOW: My table has in mind actual dismemberments. Those things will have to be very carefully looked into, it seems to me, before we are ready to say that the table is not corroborated by American experience.

I want to point out one feature that was criticized by Professor Willard C. Fisher. I am quite sure that my estimate of total disabilities was away beyond the mark. He said he was sure there was not any such number of permanent total disabilities in this country. He pointed out data indicating 33 instead of 110. He pointed out data in Washington for two years. I have analyzed those data for each year separately, and have found that the proportionate number of permanent total disabilities increased with every year. I think in another year or two it may reach 110, or may possibly exceed it. I think the same situation will obtain in the case of permanent partial disability.

MR. I. M. RUBINOW:

AUTHOR'S REVIEW OF DISCUSSIONS.

I appreciate Mr. Ryan's difficulty in discussing my early paper on "Scientific Methods of Computing Compensation Rates." Events have been moving so swiftly in this field of scientific inquiry, and especially was so much contributed to the theory of compensation rates by the Joint Conference over which Mr. Ryan so wisely presided, that my paper at present has a historical interest only; and yet sufficient time has not elapsed to emphasize its possible historical value in shaping the first steps towards a true theory of rates.

There are a few points, however, on which still some misunderstanding seems to exist. It may be true that the Standard Accident Table will have to be modified so as to fall in more closely with American experience, both as to the physical injuries, and to their judicial and administrative interpretations. But the method of computing differentials by means of some standard accident table (whether credited to me or to anyone else), and the method of utilizing law differentials in the computation of rates will retain its very important function.

Mr. Ryan expects "the law differential will soon have to give way to experience in the determination of rates." If by that, the experience of individual states is meant, such a simplified method will be possible only in regard to very few classifications. Books and shoes and textiles in Massachusetts, clothing in New York, coal mines in Pennsylvania, will, in a few years, develop a sufficient amount of such experience. But for the thousand and one minor classifications some method of combination becomes necessary. Without entering at this place upon any criticism of Mr. Mowbray's suggestion (as outlined in his paper in Vol. II, p. 124) it will be admitted that in the very nature of things it permits of a very much greater margin of error than may lurk in the law differential. In all such minor classifications, therefore, the combination of the experience of different states will be absolutely necessary and such combination would be highly inaccurate unless adjusted through a system of law differentials. As a matter of fact, this method has already been widely utilized in the work of the Pure Premium Committee of the Joint Conference.

Mr. Ryan is entirely right in stating that "in theory there should be a similar table (*i. e.*, similar to the Standard Accident Table) showing the relative gravity of accidents for each of several classes of industry," but of course each application of pure theory to real life must be tempered with reason. Upon this suggestion, two limitations may be placed: First, these specialized industrial standard accident tables (as we might call them) need not be as complicated as the original one. It would seem to be sufficient to estab-

lish the varying percentages of the five main groups of accident gravity (death, permanent total, dismemberment, permanent partial and temporary total). The average cost of an accident in each one of these five groups will surely remain fairly constant. What is subject to fluctuation is the comparative frequency of these groups as such. The law differential can therefore be computed for each one of these five groups separately (as a matter of fact this was done for a good many states by the Differential Committee of the Workmen's Compensation Service Bureau), and the final differential for the industry will result from the proper weighting of these five differentials.—Second, from the standpoint of pure theory, a separate complicated computation of the kind described above for each one of the fifteen hundred classifications indicated would seem to be necessary. But as a matter of fact, if it were possible, *i. e.*, if we did know so much about accidents normally to be expected in each industry, then it would perhaps be also unnecessary—rates might be compiled from accident experience alone.

However, all that may be expected in this world of sin from standard tables (and differentials) will be the computation for large subdivisions of industrial activity, such as the textile industry, iron and steel, mining, leather, etc. Such separate tables and differentials are not at all impossible. With the compensation business already exceeding sixty million dollars in annual premiums, and rapidly approaching a round hundred million dollars, and with a Joint Conference of insurance carriers and public authorities for the determination of rates, actuarial work of such finesse is entirely feasible, as the cost would not be prohibitive and the sources of statistical information which have made the Standard Accident Table possible—considerably enriched since then by a flood of American data—will yield all the information necessary for the special industrial accident tables.

There is only one more very serious misunderstanding which I feel called upon to correct because it is perhaps more common among actuaries than statisticians, and has crept even into Mr. Ryan's valuable discussion, namely, that the distribution of industries would materially affect the accuracy of the standard law differential and thereby introduce an error. The manual of rates for Pennsylvania is based upon an average law differential of 1.02, comparison being made with the original Massachusetts Act. "The industries of Pennsylvania, upon the whole, are more hazardous than those of Massachusetts so that we may expect the experience to develop an actual differential which is considerably higher than 1.02."

In this statement, the word "differential" is used in two different meanings. If, in the latter statement by "differential" is meant the true proportion between the "average pure premiums" of the total exposure, then it is evident that this average pure premium which is about thirty-six cents in Massachusetts and may

perhaps rise to \$1.00 in Pennsylvania will depend upon the hazardous character of Pennsylvania industries, more than upon any differences in law. It is evident that a comparison of the pure premium on coal mines in Pennsylvania and textiles in Massachusetts would not present a *fair test* of the Pennsylvania law differential.

Again here some actual experience was obtained in the course of the work of the Joint Conference. When the average pure premiums of the four states were compared they seemed to diverge very widely from the theoretical differentials. For a time the author of the Standard Accident Table felt very much disheartened. But when the differences in the distribution of industries were taken into account (by a method elaborated by Mr. Michelbacher and the writer and perhaps too complicated to be explained here in detail) the difference between the theoretical and actual differential shrank considerably. For the remaining discrepancy two explanations may be suggested—either that the original law differential was wrong (which is after all a possibility) or that the influence of still another factor—that of differences in comparative accident frequency within identical industries—manifested itself. While sufficient statistical information was lacking to determine which of the two explanations was nearer the truth, the fact is significant that the excess in the average pure premium manifested itself clearly in the western states, where a higher accident frequency is suspected, and perhaps still more significant is the fact testified to by Dr. E. H. Downey, that the proportion between the average pure premiums of Michigan and Wisconsin—two western states with similar industrial activities—corresponded exactly to the proportion between the respective law differentials.

The entire subject of law differentials presents to the author the most fascinating chapter of the new actuarial science which our Society is building up at present. It is a matter of reasonable pride in the achievements of American science that even thirty years of European experience failed to develop this valuable theory of differentials. The writer trusts that for these reasons his paper, the first to be presented before the Casualty Actuarial and Statistical Society of America, will retain some permanent value which its intrinsic worth alone would not justify.

HOW EXTENSIVE A PAYROLL EXPOSURE IS NECESSARY TO GIVE A DEPENDABLE PURE PREMIUM.—ALBERT H. MOWBRAY.

VOL. I, PAGE 24.

WRITTEN DISCUSSION.

MR. ARNE FISHER:

Mr. Mowbray in this paper discusses the application of the Gaussian Normal Curve—or as he prefers to call it—the “Law of Error” to the test of pure premiums in compensation rates. This particular curve is a special case of the Charlier A type of frequency curves as expressed by the series

$F(x) = \phi(x) + A_3\phi^{III}(x) + A_4\phi^{IV}(x) + A_5\phi^V(x) + \dots$, (I)
where

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

ϕ^{III} , ϕ^{IV} , ϕ^V are the derivatives of the curve $\phi(x)$. M , σ , A_3 , A_4 and A_5 certain statistical constants (characteristics) of the curve.

When all the terms in (I) except the first one vanish, or may be neglected as small quantities, we have $F(x) = \phi(x)$, which is the Gaussian normal distribution in the modern notation as used by the English biometricians of the Pearsonian school and the Scandinavian statisticians and which expresses the deviations from the mean value in units of the dispersion (standard deviation). Mr. Mowbray uses the classical Gaussian form for $\phi(x)$. In statistical work it is, however, preferable to use the modern form instead of the classical notation which is used in precision measurements.

The point binomial $(p+q)^s$ for large values of s may approximately be written as $\phi(x)$ when both p and q lie close to $\frac{1}{2}$. However, in the majority of cases, the curves are skew, or p and q differ considerably from $\frac{1}{2}$, and we must therefore adopt the Charlier type A and compute additional terms of formula (I). For small values of q the type A does not hold, and we must resort to another form, the Charlier B type, of the frequency curve as expressed by the formula:

$$F(x) = B_0\psi(x) + B_2\Delta^2\psi(x) + B_3\Delta^3\psi(x),$$

where

$$\psi(x) = \frac{e^{-\lambda} \sin x\pi}{\pi} \left\{ \frac{1}{\pi} - \frac{\lambda}{1!(x-1)} + \frac{\lambda^2}{2!(x-2)} - \frac{\lambda^3}{3!(x-3)} + \dots \right\}, \quad (II)$$

B_0 , B_2 , B_3 , λ , \dots are certain characteristics.

Whenever p or q is small this form gives much better results than type A and is easier to handle in practical computations. In type A it is in such cases necessary to compute 3, and often more terms, which when using the methods of moments in fitting the

curve, requires a large amount of labor. In type *B* it is in most cases sufficient to compute two terms only as for instance is shown in my paper in the *Proceedings*, Vol. II, p. 70.

Turning now to Mr. Mowbray's numerical illustrations, I think the values he gives for q are to be considered as small, which leads us to one of the decidedly skew curves of the *B* type. At any rate it is readily seen that the first term in type *A* does not suffice. For this very reason I regret to state that I can not agree with the numerical computations as given by Mr. Mowbray. This fact, however, does not in the least diminish the value of the paper, which I trust will prove a stimulus to an extended study of skew frequency curves by the members of the Society.

There is another matter I wish to mention in this discussion. Mr. Mowbray apparently assumes an unique correspondence between mathematical probabilities and statistical frequency rates (empirical probabilities). As probably some of you know from my treatise on "Probabilities," I am a rather outspoken opponent of such views. A mathematical probability rests wholly on a philosophical definition. A statistical probability is derived wholly from empirical methods and may perhaps have very little in common with the mathematical probability. Yet one sees, almost daily, statisticians apply the laws of mathematical probabilities to statistical probabilities without testing if such statistical probabilities may be considered as approximations of the mathematical probabilities. Such a procedure I think is wrong. It is really surprising why one sees so few tests about the stability of statistical series when we in the Dispersion Theory and the associated criteria of Lexis and Charlier have a very simple method—and an extremely practical one—to test the presence and magnitude of perturbations in statistical series. Mr. Mowbray's investigation I think would probably have yielded better results, if he had based it on the theory of dispersion.

MR. ALBERT H. MOWBRAY.

AUTHOR'S REVIEW OF DISCUSSION:

I am very glad indeed that Mr. Fisher has been induced to review my paper. The one point of greatest doubt in my mind at the time of presenting it was the propriety of using Gauss' Normal Curve. It was very apparent that the frequency function was more truly represented by a skew curve, but only a small section of the curve was to be considered, and this at about the mode which it seemed might have justified it. Mr. Fisher apparently feels that sufficiently accurate results could not be obtained by this method. He is a better judge on this point than I.

At a later time I hope to do some further work on the problem along the lines suggested by Mr. Fisher, but trust that if he or some other member of this Society finds time in the meantime for such a

study this will not deter them from making it and presenting us their results.

While, as noted in the paper itself, the extent of chance variation in the incidence of loss is only one element in the determination of the question under discussion, it is a most important element. As experience accumulates and particularly if some method of grouping and weighting is adopted for determining pure premiums by formula, it will become more and more important to have clearly in mind some standard of exposure to be considered dependable.

THE ESSENTIAL FACTORS IN THE COMPUTATION OF THE COST OF WORKMEN'S COMPENSATION.—W. N. MAGOUN.

VOL. I, PAGE 173.

WRITTEN DISCUSSION.

MR. GEORGE D. MOORE:

When one is in entire agreement with the essential factors of a paper, it is a difficult problem to discuss it, except to bring out in bold relief certain statements occurring therein.

A single sentence in Mr. Magoun's paper reading as follows: "It goes without saying that such a refinement in classifications is impossible for statistical purposes in general," has caused me to suggest that the title of the paper should be changed to read: The Essential Cost in the Computation of the Factors in Workmen's Compensation Insurance. Following this line of argument, I shall discuss some of the practical difficulties that have arisen in the attempt to obtain those statistics which are deemed necessary, confining myself to the factor of exposure—the other factors such as Uniform Classification of Causes of Injury and Nature of Injury having at this time been practically standardized and a system of gathering the data having been compiled by the Statistical Committee of the Workmen's Compensation Service Bureau.

It would seem as though one of the causes why the extraordinary demand which now exists for actual and dependable information has not been met is fundamental. The factor of exposure is based on payroll and this in turn is classified in accordance with current underwriting practice. The workmen's compensation classification code is an outgrowth of the now almost obsolete employers' liability business and this due to competitive methods has been extended and refined until it would seem as though further refinement could not be made. However, witness the special classifications which have been promulgated by the New York Compensation Inspection Rating Board since the advent of workmen's compensation in New York. This refinement has continued, so that we have over 1,200 classifications; such a large number becomes both a menace to accuracy as well as to the possibility of collecting

and tabulating exposure by classifications. The accuracy of the data is in direct proportion to the number of classifications and the more classifications are added the more difficult it is becoming to furnish such detailed and at present perhaps necessary analysis. The most difficult and comprehensive analysis at the present time, "Massachusetts Schedule Z," as has been pointed out by Dr. Downey in a former article, indicates that after a lapse of five years, only about thirty manual classifications will give an adequate exposure, and yet we are obliged to tabulate all of these minor classifications without obtaining any dependable data whatever.

Now, gentlemen, those present who have had or are now having actual experience in the compilation of this schedule, in all truthfulness what would you say if each and every state of the many now having workmen's compensation laws were to require a similar schedule? And yet upon the present basis for rate-making that is the method which should be followed. My endeavor is to bring out if possible a further discussion in the interest not only of an opposition to a further refinement but a curtailment of those classifications which we have already. It may be that the solution of the problem does not lie with either Dr. Downey's "entrepreneurial method" or the "risk classification method" of the present system. It may be that a modification of both of the systems will give us the desired result. If such a refinement is at present impossible for statistical purposes in general, why not in particular? We are all interested in keeping the cost of the administration of the business at as low a point as possible and yet this item of the cost of compilation is becoming more and more serious each year as well as becoming more and more involved. Perhaps the fact of the matter is that the basis manual should have been compiled by statisticians and engineers instead of by underwriters; the statisticians to consider the essential features from an actuarial standpoint so that dependable data could be obtained upon which to build the rates scientifically and the latter to group the analogous hazards. The manual should then have been left to the underwriters to be applied in covering the risks. The grouping of analogous hazards as has been pointed out has been attempted with more or less success by the Manual Committee of the Workmen's Compensation Service Bureau as witnessed in the new Basis Manual, but this or a similar grouping must be speedily recognized by all parties interested if any relief is to be obtained.

What method presents itself? Not surely by the addition of more and more classifications *ad nauseam*, as pointed out by Dr. Downey. No, certainly not. It may be found, however, in the groups which have recently been adopted. We are now coming to a time when enough dependable data on the larger classifications can be obtained. At least this may be so if we group the data tabulated from various states together. Why not then let us establish for each group a basis rate for each state separately? The

variations from the basis rate for each classification within the group might have a maximum, say of 20 per cent., not greater than 10 per cent. or less than 10 per cent. of the basis rate. These variations to be founded upon present obtainable data or where the data is insufficient, the use of Mr. Mowbray's* formula for "The Determination of Pure Premiums for Minor Classifications on which the Experience Data is Insufficient for Direct Estimate" can be applied. After the establishment of these factors why not disregard the keeping of statistics on individual classifications, confining ourselves to a set of groups, say 300 in number. The tabulation of this data by statisticians should not be unbearable to anyone and would tend to greatly strengthen the standardization of rates. Of course there is the objection that would be raised that a certain class within the group would become in time less hazardous due to improved machinery and appliances and the measure of this improvement could not be obtained for rate reduction purposes inasmuch as the experience was absorbed within the group of which that class formed a part, but any such improvement should appear in a more favorable pure premium on the group as a whole and could be studied in this connection.

If in the plan proposed it would be impossible to obtain the experience on certain classes within the group, is it not a fact today that the effect of schedule rating applied to certain classifications is absorbed by the experience of those classes as a whole, and there is no endeavor being made at the present time, that I know of, to keep the experience on schedule rated policies separate.

The foregoing are thoughts that have occurred by the way, and I believe would require intensive study to make them of practical value, but something must be done in the near future or we will be completely swamped by the vast increasing amount of statistical information which is being required of us.

ORAL DISCUSSION.

MR. HARWOOD E. RYAN: I want to say a word in regard to what Mr. Moore has said about classifications. I think we are misled, somewhat, about the classification so far as it relates to experience statistics. As a matter of fact, the classification is fast losing its usefulness excepting as a cross reference for the convenience of the underwriters and employers in finding the rate. The rate is composed of certain elements made up from group experience, and if we had an absolutely ideal system of grouping the classifications, you could have any number of classifications without multiplying the difficulties of getting experience data on the proper basis. You could lose sight of the classification, just as you do in personal accident experience. What you do there is to look down the list of

* *Proceedings*, Vol. II, p. 124.

classifications and then assign the risk to the proper hazard group; you then ignore the classification, so far as experience is concerned, and the experience used for rates is the group experience. I think we need not be too much worried about the multiplication of classifications, for it serves to show that the policyholder is being put in the right pigeonhole, and that, after all, is the main reason why the manual has reached such large proportions.

MR. W. N. MAGOUN.

AUTHOR'S REVIEW OF DISCUSSIONS:

One thought has occurred to me in connection with Mr. Moore's discussion, and that is whether there is not a connecting link between the system of experience rating which may be developed and the reduction in the number of classifications—that is, by consolidation of several into one, and eliminating the unnecessary ones by a system of grouping. We are accustomed, I believe, to think of experience rating as a means of providing different rates for two plants that appear physically the same. One has a better experience because of the moral hazard of the plant than the other, and that is reflected by experience rating. But the thought I want to bring out is this: In the manual we have such classifications as valve manufacturing and clock manufacturing. Now, there is no difference in the base rate for the man who makes a very large valve and the one who makes a very small valve. Is it not going to be true that the man who makes a very large and heavy valve may reasonably be expected (other things being equal) to develop an experience which will increase his rate whereas the employer who makes only a very small valve will develop an experience which will reduce his rate. In other words, will it not be true that experience rating may take care of a situation at present unsolved, namely, that of adjusting the rate according to the size and nature of the product of a particular risk within a given classification entirely apart from the question of the moral hazard of such risk. It would seem to me that such a result would tend to make possible a reduction in the number of classifications in the Manual without causing any injustice to the individual assureds.

There are two other points in Mr. Moore's paper to which I would like to refer.

First, in respect to the grouping of industries. Industries may be grouped according to the nature of the business or according to the degree of risk of injury. The International Association of Industrial Accident Boards and Commissions has completed a grouping of industrial classifications, and this grouping proved to be of value at the Joint Conference* on Workmen's Compensation Rates

* See proceedings of the Joint Conference published by the Insurance Department of the State of New York, p. 20.

held in New York City during the latter part of the year 1915. This grouping has the endorsement of the Casualty Actuarial and Statistical Society of America.*

In utilizing a grouping based primarily upon the nature of the business, however, for rate making purposes, it is essential that underwriters and engineers shall determine the varying degree of hazard within a group. A group may contain a number of classifications, all of a similar character so far as pertains to the nature of the product manufactured, and yet there may be a wide variation in the hazard.

A grouping in accordance with the degree of risk of injury means a grouping together of classifications which should take substantially the same rate. So far as I am aware no such grouping at present exists. It can only be prepared from experience and the experience necessary for the compilation of such a grouping must of necessity be built up from the experience in each individual classification. It would seem to be necessary, therefore, for some time to come to keep the individual experience by classifications if we are to ultimately have a grouping for rate making purposes along the lines suggested in Mr. Moore's discussion.

The other point which I wish to mention is in respect to the keeping of experience on schedule rated policies separately. The Pennsylvania Compensation Rating and Inspection Bureau has devised and is using a system of cards for the purpose of keeping the experience on all risks which have been inspected and a schedule rate established thereon. The detailed data appearing on these cards is such that many different studies may be made, for example if arranged numerically by code numbers, groups are automatically formed, which can be compared by size of payroll, credits, charges or by specific items for which credits or charges are made. The Bureau is developing a record of experience, therefore, by industries showing the exact effect of each item in the schedule as it applies to each classification. This may be further refined by individual risks from the data appearing on the cards if it is desired to do so. As the cards are filed by code numbers and each card bears the Bureau file number, the system acts as an index so that if the inspection reports for any given classification are desired they may be readily obtained from the files by reference to the cards.

* See *Proceedings*, Vol. II, pp. 4-6.

SCHEDULE RATING OF PERMANENT INJURIES.—G. F. MICHELbacher.

VOL. I, PAGE 257.

WRITTEN DISCUSSION.

MR. EDWARD S. GOODWIN:

This paper presents a feasible plan of valuing automatically the great majority of that important class of injuries which are permanent in nature, through the use of arbitrary schedules, and sets forth for consideration excerpts from those which have been constructed for the purpose.

Any scale of compensation benefits to be acceptable in its entirety must produce a proper amount of compensation for all injuries in the aggregate and, at the same time, distribute compensation between specific cases in proportion to their relative importance. Further, as respects the specific case, the amount payable must be distributed to the best advantage; that is, both the rate and period of compensation must be so determined as to best serve the interests of the disabled workman.

By applying the schedules to specific cases percentages of disability are determined which may be converted into periods of compensation through the application of the arbitrary rule of granting four weeks' compensation for each one per cent. of disability. These in turn, even in the relatively few cases of more serious disabilities where life pensions follow the termination of such periods, are uniformly converted by the application of 65 per cent. of the average weekly wages into sums which represent the determined values, exclusive of life pensions, of the disabilities in terms of money. These, in the final analysis, are composite values produced by combining the influence of rates and periods of compensation which have been selected. Having in mind the source from which the schedules, excerpts of which are given, were taken we are justified in assuming that as a measure of compensation the plan produces a scale of benefits sufficiently liberal in the aggregate, and to that extent meets our requirements.

Considerable space might be here devoted to the discussion of Tables I, II and III but, as they are all based on personal judgment and have been systematically compiled, it seems best to waive any minor differences of opinion and accept them as examples of constructive effort and proceed to consider the problem further upon the basis of ultimate results.

Having assumed that a combination of the values of all cases as finally expressed gives an aggregate amount of compensation that is equitable the question arises as to the fairness of the plan when applied to the specific case, having in mind not a composite value but rather the correctness of both the period and rate of compensation.

At this point, the following facts may well be emphasized; that, ignoring for the time being cases involving life pensions and limits, the rate of compensation is in all cases 65 per cent. of the average weekly wage and in like manner the period of compensation in weeks is four times the finally determined percentage of disability.

It would seem that, while a fixed rate and arbitrarily determined percentages may produce correct values, they do not necessarily permit of an ideal method of distribution as respects rate and period. For instance, for a disability rated 60 per cent., 65 per cent. of wages is payable for 240 weeks; for a less serious disability, say one rated at 20 per cent., the rate remains constant at 65 per cent. but the period is 80 weeks. The resulting amount of compensation for the first 80 weeks is the same in each instance and consequently the workman most seriously disabled and therefore in need of a greater amount of assistance may receive the lower total income. To illustrate: If we assume that the determined respective percentages of disability and losses of earning power are relatively the same (and they must be at least roughly proportionate if the schedules are properly graduated) then the man 60 per cent. disabled may earn about 40 per cent. of his wages and receive as compensation 65 per cent., total 105 per cent.; the man only 20 per cent. disabled may earn 80 per cent. of his wages and receive as compensation 65 per cent., total 145 per cent. The situation is further aggravated by the fact that at the outset the more seriously injured man has a lesser chance of earning even the lower percentage of wages ascribed to him than has the other of earning the higher figure.

From the foregoing it would appear that if we assume the amount of compensation as finally expressed by the product of rate and period to be correct for each case it would seem better in minor cases of disability to extend the period with an equivalent reduction of rate. If the periods thus produced prove to be too extended then a fair assumption would be that the amount of compensation for such minor cases should be reduced, preferably through the operation of a reduction from the 65 per cent. rate, and the saving added to the benefits prescribed for the more serious cases.

A man who has been seriously disabled, say to the extent of 80 per cent., receives 65 per cent. of his average wages for 240 weeks and then a pension of 20 per cent. for life, an abrupt drop even though he may have regained a portion of his former earning power. As rehabilitation is not instantaneous at the end of 240 weeks or any arbitrary period a gradual grading off of the rate of compensation with a corresponding extension of period might well be incorporated in the plan to advantage. If in very serious cases this were supplemented by adding thereto the saving which could be made in connection with the treatment of minor cases a more humane plan would result. This is particularly true in that the 20 per cent. is supposedly a rather scant provision, in the event that

the workman has dependents incapable of self-support. Incidentally, a good distribution would follow such a grading in that compensation would be conserved to meet subsequent needs instead of being exhausted in whole or in part at an earlier date simply because it was available at that time in quantity.

In conclusion, it may be stated that the plan outlined seems to possess advantages over some existing methods of valuation in that it gives consideration to certain of those factors of importance not ordinarily considered, but that it might be improved by providing for a different distribution of the payments as respects rates and periods of compensation and possibly to a lesser degree between disabilities of varying degrees of severity. The discussion of certain features has been purposely omitted in order not to duplicate data already available in Volume XV, pages 166 to 173, *Transactions of the Actuarial Society of America*, where a discussion of Professor Whitney's views may be found.

MR. WILLIAM LESLIE:

I have only words of commendation for Mr. Michelbacher's clear and lucid statement of the compensation problem presented by permanent injuries and the attempt in California to solve that problem by schedule rating. However, no matter how staunchly we may advocate the economic and social principles involved in schedule rating of permanent injuries, we are at once struck with the vast number of assumptions based upon a priori reasoning and investigation which were required in the construction of the permanent disability rating tables described by Mr. Michelbacher. A certain fear is bound to creep into our minds as to whether or not the tables applied in practice will measure with sufficient accuracy the degree of disability which is likely to result from a certain injury. In making any practical tests to determine the accuracy of the tables, there should be borne in mind Mr. Michelbacher's statement to the effect that the tables deal with the average man so far as education, health, adaptability, etc., are concerned and sufficient cases should be examined to make this average man the basis of the test.

In advance of a practical test, one would be very much more inclined to believe in the accuracy of the tables if more stress had been laid on the reasons for making certain assumptions and, where experience elsewhere had been followed, the reference had been given.

Very briefly, what are the points about the construction of the schedule, which may lead us to doubt its correctness?

In establishing a relation between the ratings for the same injury and occupation at age 15 and age 75, Mr. Michelbacher quotes Professor Whitney's original assumption that a 10 per cent. disability at age 15 corresponds to a 20 per cent. disability at age 75.

He then states that the tables were based on the assumption that a 10 per cent. disability at age 10 corresponds to a $17\frac{1}{2}$ per cent. disability at age 75. This change has evidently been made because of a resulting simplification in the formula connecting ages 39 and 75. It seems like a confession of weakness as regards the accuracy of the assumption, because a change of $2\frac{1}{2}$ per cent. in a rating at age 75 is very considerable. In fact, it is just one-half the amount of change in the ratings at 75 found upon going from one table to the other. At this point of his paper I believe Mr. Michelbacher should have explained fully the basis of Professor Whitney's original assumption, together with the reason and justification for modifying it. As it now stands, one is led to believe that it would be fully as correct to say that a 10 per cent. disability at age 15 corresponds to a 15 per cent. disability at age 75 or that a 10 per cent. disability at age 15 corresponds to a 25 per cent. disability at age 75. Under the California law, which allows four weeks' compensation for each one per cent. of disability and a maximum weekly compensation payment of \$20.83, a difference of even $2\frac{1}{2}$ per cent. may mean a difference of as much as \$208.30 in the amount of compensation payable. The tables themselves have been worked out to give ratings to one-fourth ($\frac{1}{4}$) of one per cent. and, therefore, the relation between the ratings at ages 15 and 75 should be established on a basis which we are reasonably satisfied is more substantial than guess work.

The assumption has been made that a boy of 15 has perfect power of accommodation and a man of 75 has none. Further, that this power of accommodation is a linear function of the age and decreases uniformly with the increase in age. How would a change in this assumption affect the tables? Suppose instead of assuming ages 15 and 75 as the lower and upper ages respectively, ages 20 and 60 had been taken. A new assumption connecting the ratings at ages 20 and 60 is all that would have been required, which presumably could have been determined as accurately as the one used. A change, therefore, in the limiting ages of the tables would only change the ratings between the limiting ages in so far as it would affect the correspondence between the ratings at the upper and lower ages. Suppose, however, that instead of the power of accommodation being a linear function of the age, it were to decrease rapidly between ages 15 and 30, stay nearly constant between ages 30 and 45, decrease rapidly again between ages 45 and 65 and then decrease slowly to age 75. This or any other similar assumption might be made and could probably be supported by fairly conclusive reasoning. It would obviously make a material difference in the ratings at various ages.

In constructing the plus and minus tables, additions were made to the ratings at age 75 and by keeping the ratings at age 15 constant the ratings for intermediate ages were found by interpolation. Is it correct to keep the ratings at age 15 constant for the

same injury in all occupations? If for the standard table there is a certain relation between the ratings for ages 15 and 75, then should the same relation exist for other tables? The tables about which Mr. Michelbacher is talking have been formed on the basis of one set of answers to these questions. What result would it make in the tables to assume for instance that the ratings at age 15 should vary for different tables or that the same relation between the ratings at ages 15 and 75 should exist in all tables, or that both of these conditions should exist? How would such tables work out when applied to practical cases? The answers to these questions would involve considerable work, but would undoubtedly be extremely interesting. They do not affect the theory of schedule rating but they do affect its practical application very materially.

The assignment of ratings to various injuries for the standard man and the assignment of occupations to various forms depends upon judgment, backed up by foreign experience and local investigation, and, therefore, may be right or wrong according as the judgment used was good or bad. This condition would exist no matter how correctly the assumptions used in preparing the tables had been made. It is one of the necessary evils attending the introduction of a new plan, for which there exists no statistical basis; but it is in my opinion of minor importance as compared with the construction of the tables themselves. It will take but a comparatively short time to accumulate sufficient data on which to establish relative ratings for injuries and occupations, but it will take a very long time to collect enough data to determine the relation between the ratings for different ages.

It is rather interesting to note that California statistics show the average age of injured workers to be lower than 39. I presume this age was taken in the construction of the tables because of a calculation made by Professor Whitney, which is described in a publication of the California Industrial Accident Commission as follows:

"It was assumed that a man of age 39 could be taken as typical of the whole working population; that is, that the average cost for compensation to all workmen as a whole would be the same as the cost for a man of 39. This was based upon an actuarial computation of the cost of compensation among a population between the ages of 15½ and 59½. These limits were taken after a study of the census figures for California."

The establishment of the 52 occupational groups is particularly commendable, not only because of the greater ease in constructing the original tables, but also because of the readiness with which it lends itself to the rating of additional occupations.

ORAL DISCUSSION.

MR. I. M. RUBINOW: There is quite a difference in the character of Mr. Michelbacher's and Mr. Goodwin's papers. I agree with a good deal that Mr. Goodwin has said in his paper. Of course, Mr. Goodwin's criticism should have been directed toward the ordinary dismemberment schedule as well.

I think the California plan has been overestimated, although there are two very definite virtues of that plan which I think need not be minimized. But because of these two existing virtues the fact has been disregarded that there are a great many faults in the remainder. There are two reasons why the California schedule is superior to any of the twenty-seven dismemberment schedules existing in the various states, and they are that it recognizes the influence of age and occupation. Whether these factors have been properly weighted or not I don't know. Of course, nobody knows. Take, for instance, the assumption that the factor of age is a constant, so that compensation increases on the assumption that the injury or disability increases in direct proportion to the rise in age. That is a rather broad assumption. I don't know what there is to substantiate it. I somewhat doubt it. The best thing that can be said of the California schedule is that it presents the judgment and observations carefully made by careful and honest people.

I am discussing the California plan rather than Mr. Michelbacher's paper, because he has correctly and carefully described that plan. After we have given those two credits to the California plan, I think we all recognize that it carries several faults. It still retains full payment for part time in cases of disability that are partial in character and may last for life.

Now, there is one criticism that may be made of the California plan. I am not familiar with the conditions in California, and do not know whether the schedule has any binding legal force or not.

I am always suspicious of a statement that any particular law is satisfactory to everybody. If you talk to people in New York, everybody is satisfied with the New York act. If you go to Massachusetts, you have the official statement that the act is satisfactory to everybody. The fact that no one kicks is not evidence that a plan is a good one.

A peculiar feature of the California Act is that it recognizes temporary and partial disability. Now, if a man suffers from temporary partial disability, he is entitled to get partial compensation as long as the temporary disability lasts, which may be three hundred weeks. No one can tell whether the thing is temporary or permanent until the man is dead. After that, of course, we know there is no chance of improvement. There are a great many conditions which I think need not necessarily be permanent. So there is at least in law a selection between the two methods. The criticism of the California system is that it begs the entire question.

If you take the German or Austrian experience you will see after thirty or thirty-five years they have at least developed a large body of experience. They have had hundreds of thousands of permanent partial disability cases which have been adjusted by all kinds of people, and as a result of those thousands of adjustments and thousands of discussions, considerable judgment has been involved. As a matter of fact, in Europe they use dismemberment schedules in an advisory capacity, indicating the probable disability in various injuries dependent upon various occupations, and a man can study those books.

Now, if you assume that you know it all, and adjust your injuries on that know-it-all theory, then you lose all your chances of learning by experience. The California people had the opportunity to get the experience. I have no criticism to make of Mr. Michelbacher's actuarial or mathematical basis. But the trouble is that it also assumes the correctness of the original schedule, for which there was no basis of information. Secondly, it assumes the absolute correctness of the rehabilitation theory, which I think in many cases is obviously incorrect. I doubt the basis of truth of that principle.

I think that people injured so as to suffer permanent disability are entitled to specific consideration, just as a patient who comes to a doctor is entitled to have himself examined and not be treated according to actuarial formulas. I think you will recognize that that comparison is a valid one.

We are dealing with social diseases. I have not the time to analyze the cases that Mr. Michelbacher mentions; but the fact that your arithmetic balances will not furnish a man or his widow with bread and butter.

MR. ALBERT H. MOWBRAY: I would like to call attention to the fact that the fundamentals of the California plan were presented by Professor Whitney in a paper before The Actuarial Society of America appearing in the *Transactions*, Vol. XIV, p. 308 et seq. The discussion took place at the next meeting and is reported in the *Transactions*, Vol. XV, p. 166 et seq. I think it would be well for the students who wish to follow the whole problem to read this paper and discussion. It is also perhaps in order to point out that some of the members of the Massachusetts Industrial Board were rather favorably impressed with the California plan, and certain studies were made by employees of the Board in Massachusetts of typical cases, and those are reported in the second annual report of the Industrial Board of Massachusetts, which, perhaps, will throw some light on this discussion from a practical point of view.

MR. G. F. MICHELbacher: The question of partial temporary disability is disposed of by applying the definition of "permanent injury" to the individual case. If a man has not lost a function or a part of his body, he receives compensation for partial temporary disability while partially disabled.

MR. RUBINOW: Of course, every injury is the loss of a part of the body or the loss of a function.

MR. MICHELbacher: I mean permanent loss of function or dismemberment. A man must have suffered an injury resulting in a stiff finger, or the partial loss of an eye, or a dismemberment, if he is to be considered permanently disabled. If the injury results in a bruise or a fracture, or a disability of that character, a man receives compensation for total disability while the total disability lasts, and then compensation for partial temporary disability as long as partial disability lasts, with, of course, proper regard for the limits set forth in the Act. I think that answers that question.

About the theory itself, I don't think Professor Whitney ever intended the theory to be absolutely scientific in every way. The question of considering the power of accommodation a linear function, as far as age is concerned, has been discussed a great deal. Mr. Phillips of St. Louis, for instance, assumes that the power of rehabilitation varies with the hardening of the arteries, and has used blood pressure statistics to develop a more or less complicated theory of accommodation.

MR. RUBINOW: My objection is to that method without individual attention.

MR. MICHELbacher: The man does get individual attention. These cases remain within the jurisdiction of the Commission for 245 weeks. If the Commission finds that an award is excessive, it may decrease it or it may increase it if it is found to be insufficient.

I am not in favor of using detectives to trail a man in order that his compensation payments may be terminated as soon as he helps himself by making an honest attempt to secure employment. This method takes away the incentive to get out and find a job. The proper method is to encourage the injured man to secure work in which he can use his injured member, and for that reason we give each permanently injured employee the amount of money which we have determined the average man of average health and of average inherent adaptability in each occupation requires to enable him to get on his feet again and then turn him loose to find his own salvation. The period of time covered by these payments gives the average man sufficient time to rehabilitate his earning capacity. If the amount awarded in this manner is excessive, a certain part must be considered a subsidy well spent in re-creating an honest and industrious worker. If it is not sufficient to cover the actual period of disability the following section of the Workmen's Compensation, Insurance and Safety Act provides additional compensation to carry the worker along until the disability has terminated: "Nothing contained in the foregoing schedule of permanent disability indemnity shall be held to limit the amount of compensation recoverable for any such permanent injury during any period of total incapacity resulting from that injury."

MR. G. F. MICHELbacher.

AUTHOR'S REVIEW OF DISCUSSIONS:

I think Doctor Rubinow assumes that the rehabilitation theory has been accepted absolutely in California and carried to its logical conclusion in the provisions of the law relating to Permanent Disability. I pointed out in the second paper that this theory has not been accepted in California for serious permanent injuries. That is to say, there is a limit beyond which the injured employee in California is assumed not to be able to fully regain his lost earning capacity, and it is for this reason that pensions are allowed for serious permanent disabilities. In other words, it is assumed that the rehabilitation theory works well up to a 60 per cent. permanent injury, and that if a man receives an injury which is rated over 60 per cent., he cannot fully regain his earning capacity; that handicapped by so serious a disability, he cannot be expected to regain more than a maximum of 40 per cent. of his former earning capacity and for that reason some permanent pension must be provided to make up the difference between what he can theoretically earn and 40 per cent. of his former earnings—the amount he must be given to insure his own upkeep.

Under this theory payments are made for 240 weeks to enable the injured man's family to rehabilitate itself, and then following these payments the injured man is given a sufficient permanent pension to enable him with the amount of wage he is physically able to earn to take care of himself. It is taken for granted that the family will get along satisfactorily after the payment of compensation for 240 weeks—the period for which death payments are made.

Now, as far as the California plan is concerned, it is an attempt, under the present system, to administer the Workmen's Compensation Act automatically. There are plenty of checks and balances. Doctor Rubinow has pointed out that the Schedule is not a hard and fast rule. It is not necessarily adhered to in each decision. In fact, there are several decisions of the Commission where the Schedule has not been strictly followed. The Schedule has been adopted by the Commission as a guide, and I think nearly every one will agree that some sort of guide which will insure a standard method of taking care of these cases is perfectly legitimate.

When I spoke of the present method of administering Workmen's Compensation Acts, I referred to the absolute impossibility of rating permanent disabilities in, say, California in exactly the same way as they are rated in Europe. If you will take the definition of permanent injury which we use in California, namely, an injury that involves either the loss of a function or a part of the body, you will find that there will be in the neighborhood of six hundred cases per year, or two or three cases for each day the Commission offices are open. The Commission at the present time is

almost flooded with litigation, and as this pressure increases, the personal attention which the Commissioners are able to give these cases is, of course, diminishing. I venture to say the decisions of the Commission are now largely written by a legal department and are in the majority of cases merely signed by the Commissioners. Of course, that is not a commendable state of affairs. It is absolutely essential that the procedure be limited to cases where there is actually a controversy. The Schedule has reduced the number of cases heard by the Commission by, I should say, one-third, and has therefore allowed the Commission more time to deal with cases that involve real mooted questions.

With reference to Mr. Leslie's discussion which is devoted almost entirely to a review of the assumptions which were made at the time the schedule was constructed, it should be pointed out that in general the assumptions were made as simple as possible. It was realized that there would be considerable opposition to a schedule based upon empirical assumptions and in order to remove any obscurity which might be introduced by the use of complicated formulas of one sort and another, it was thought wise to limit the application of the theory to as simple a form as possible. For this reason, the power of accommodation was assumed to be a linear function of the age. This permitted the use of simple interpolation in deriving the values for the various ages. The fact that these values are carried to the fine point of one-quarter of one per cent. need not necessarily prove their incorrectness, for this refinement was made in order that attempts to use the table for various ages would produce uniform results. If the table had been computed for every tenth age, for example, it would not have been necessary to make this refinement, but in the use of a table of this character for intermediate ages, it is absolutely certain that an attempt would have been made to interpolate a value for the age in question. Realizing this fact, values were computed for odd ages and a rule was inserted in the schedule requiring the use of a definite procedure in determining ratings for all ages. This provision has had the effect of definitely establishing one rating for each injury, age and occupation.

As I have stated, the assumption that the power of accommodation is a linear function of the age has been severely criticized. It is probably not the scientifically correct assumption, but any other theory with reference to this assumption can be based on nothing but a more elaborate hypothesis, and with the idea of simplifying the theory underlying the schedule, the assumption of a linear function was the simplest assumption that could be made.

With reference to the assumption that the ratings at age 15 should not vary for different tables, it is merely necessary to point out the fact that there can be no occupational factor in the case of a boy of age 15, for it is difficult to conceive of a case where a boy of age 15 has become definitely established in an occupation. To

be sure, there may be cases where a boy of age 15 has entered upon his period of apprenticeship, but a provision in the Act requiring that compensation be computed on the basis of the wage this boy will theoretically earn at the attained age of 21 removes any possibility of discrimination in his case. The fact that the relation is the same between the ratings for ages 15 and 75 in all tables is again an assumption which makes for simplicity. Other methods have been suggested and Mr. Phillips of St. Louis has even gone so far as to eliminate all tables except Table "A" and to provide a series of factors or differentials whereby ratings in this table may be extended to cover the various degrees of occupational use.

The assumption of 39 as the average age has caused considerable controversy, principally because no one has ever been able to check this figure. The fault probably lies with the writer who has not made clear the reason for this assumption. Age 39 is not the average age of workers who are injured in California. As a matter of fact, it is slightly higher than the average age of injured workers anywhere in the United States. It is, however, the average age of the working population in California and was taken only after a careful computation which involved the use of population figures taken from the 1910 census for California. Using these figures, it was ascertained that the average age of persons between the ages of 15½ and 59½ in the population of the State was 36. On the assumption that age 65 is probably more nearly the "scrap-heap" age of industrial workers, this result was advanced to age 39. It should be noted that in this computation the population of working age was taken and that no attempt was made to find the injured workers' population or the working population. It is also interesting to note that age 39 is the average injured annuitants' age in California, this fact having been established by the following computation. It was assumed that 8,892 injured persons were sent to purchase 3½ per cent. life annuities computed on the basis of the American Experience Mortality Table for their respective ages. In order that these annuities might more nearly conform to the compensation payments, the continuous annuity was used as a basis for this computation, as the value of this annuity is a very fair approximation of the value of the annuity which is payable fifty-two times per annum. It was determined that the cost of these 8,892 weekly life annuities would be \$159,102.41, or an average cost per annuity of \$17.8928. The cost of a similar annuity computed for age 39 is \$17.1946. Consequently, age 39 may be assumed to be a very reasonable approximation when the interest rate is 3½ per cent.

The assumption of the relation between the ratings for the same injury and occupation at age 15 and age 75 was first made by Professor Whitney, who assumed that the disability for the boy of age 15 was one half the disability for the man of age 75 who had sustained a 20 per cent. impairment. In modifying Professor Whit-

ney's formula based upon this assumption, it was necessary to somewhat materially alter this assumption in order to secure a working formula. It is acknowledged that the relation which produces the result shown in the schedule under Table "A," namely, that a 10 per cent. disability at age 15 corresponds to a 17½ per cent. disability at age 75, is entirely the result of this endeavor to create a workable formula. In other words, it is an accidental result due to the desire to simplify the method of procedure, and may or may not be a "confession of weakness." You must understand that at the time the schedule was constructed, considerable study was given to the problem, not that complicated formulas might be derived, but that the formulas which were used might be made as simple and understandable and workable as possible. Any one with careful study at that time could have made an assumption substantially as correct as this one. This is admitted. But results obtained by the use of this formula were results which could be justified by general reasoning and they were consequently taken in the absence of definite information to the contrary. In this connection, the following interesting check on this assumption may be mentioned. In evaluating injuries for the standard man who had been assumed to be an unskilled worker, it was found necessary to request the aid of surgeons. The first blank prepared with this object in view asked for several estimates for each injury based upon varying ages, and it is interesting to note that in the opinion of the surgeons furnishing the estimates, the percentage corresponding to 10 per cent. for age group 20 and under was about 26 per cent. for age group 61 years and over. These limits would give a greater variation in the ratings for ages 15 and 75 than those assumed. Consequently, the rating tables, if anything, lean toward conservatism, as far as this factor is concerned.

REVIEWS OF BOOKS AND PUBLICATIONS.

A Standard Accident Table as a Basis for Compensation Rates.
By I. M. Rubinow, Ph.D., Chief Statistician, Ocean Accident and Guarantee Corporation, Ltd. New York, The Spectator Company, 1915. Pp. 63.

Contrary to what at first glance one would expect from its title, this booklet is not chiefly a table or series of tables of figures. The "standard accident table" referred to, as a matter of fact, fills one page only (or at the most two to three pages, if three or four supplemental tables be included), while the bulk of the matter consists of text description; first, of how and why the construction of the table came to be undertaken (10 pages), second, of the method of deriving the several elements embodied in it (27 pages), third, of certain supplemental factors (13 pages), and fourth, of methods of applying the standard table for practical purposes (8 pages).

The published title gives little indication of the precise scope and purpose of the standard table. What the table embraces is only distribution of accidents according to extent of disability, or more exactly, according to a classification of disabilities designed to cover the various kinds and degrees for which rates of compensation are specified in American compensation laws. Its purpose though ultimately to serve the general end somewhat vaguely indicated by the title, is, to be quite specific, to afford a basis for the calculation of the differences in cost of compensation between different state laws, that is, to calculate state differentials.

One further point is to be noted to make the nature of the table clear, and this brings out the essentially important constructive thing done by Dr. Rubinow and also indicates such justification as there is for calling it a "standard" table. The table is a composite, utilizing all available statistics, both American and foreign, which would assist in calculating what is the distribution of accidents according to extent of disability, which may be regarded as normal, so to speak. In other words, it is essentially a hypothetical table indicating in proportions per 100,000 what, according to all the statistical evidence available when the table was constructed, the distribution of accidents by extent of disability may be expected, in

the long run, to be. The measurement of differences in cost between two compensation laws is to be accomplished by calculating the cost of 100,000 accidents distributed as in the standard table, under the compensation schedules of each law.

Now the size and difficulty of the task of constructing such a table can scarcely be realized by anyone who is not familiar with the lack of uniformity both in schedules of compensation and in the statistics of experience in different countries, not to mention the entire lack of data for some items necessary for the table to make it of practical use for American laws. Dr. Rubinow's work in overcoming these difficulties, so far as possible, is a revelation both of the seriousness of such difficulties when combined experience of different countries is needed, and of his patience and ingenuity in calculations, estimates and deductions to overcome them. It is perhaps not too high a characterization to style it a brilliant piece of statistical work.

But this is not to say that the work is wholly beyond criticism. Passing over matters of typography, form, and English, concerning which, however, the booklet is not irreproachable, more serious criticism can be made of the accuracy of the estimates and calculations made in arriving at the figures in the table. Some of these, at least, when closely examined, reveal a certain looseness which tends to disturb confidence in the table. To cite only one example here, the proportion of fatal accidents adopted for the standard table is that shown by the first year's experience in Massachusetts. This was found to be 888 on the basis of the standard accident definition used for the table throughout. But the Massachusetts figure was not adopted without comparison with European experience, as the result of which Dr. Rubinow records as a check on the Massachusetts figure 837 as the average fatal accident frequency in Austria, Germany, Italy and Russia. But 837 is incorrect for this in two ways. In the first place, it is not the correct average of 1,048 (Austria), 750 (Germany), 746 (Italy), and 782 (Russia), the figures given for those countries, the correct figure being 831. This may be either an arithmetical or typographical error and is, of course, not very important. More serious is the fact that to arrive at this average, Dr. Rubinow did not reduce the Italian and Russian figures to the same basis as those for Austria, Germany and Massachusetts, that is, to proportions of total accidents causing disability of more than one day. The Italian figure used is the pro-

portion of accidents with disability of over five days, and the Russian the proportion of accidents with disability of over four days. Dr. Rubinow did not overlook this discrepancy but dismissed it with the statement that in both cases "the true average would be somewhat smaller" if such a reduction had been made. But if Dr. Rubinow had made the actual reductions by the same methods he employed in the other cases he would have found that instead of "somewhat smaller," the Italian and Russian proportions would have been reduced very considerably, from 746 and 782 to as low as 560 and 626 respectively,* and this would make the average for the four countries 746, which is far from being as good supporting evidence for the Massachusetts figure of 888 as the figure 831 calculated by Dr. Rubinow. It is, perhaps, only fair to add that defects of this sort are not so serious where, as in this case, only approximations are claimed for the work, as they would be if exactness could be expected.

Turning from details, the natural and most important query is how convincingly, on the whole, does the table support its title of "standard." To one side of this question, considering it, that is, as a formulation of what such a table must contain, the answer must be decidedly favorable. In this respect, the value of Dr. Rubinow's service in laying a strong foundation for future development is clear. But on the other side, the figures worked out in this particular table are by no means so convincing. Let us hasten to add that lack of conclusiveness here is not the fault of Dr. Rubinow. It is due rather to the character of the materials available for the purpose. On the whole, the present reviewer is inclined to think that in view of what he had to work with, Dr. Rubinow probably made as good a table as could then be made. But after following through the almost tortuous calculations, estimates, and piecing together required for most of the table either to arrive at any figures at all, owing to almost total lack of appropriate data, or to make possible comparison of data from different sources, one cannot but be impressed with the inadequacy of the data for the achievement of conclusive results.

* It should be explained, perhaps, that to make these computations it was necessary to assume in the table given by Dr. Rubinow on page 18 an even distribution of accidents causing disability of 1 to 7 days, and for convenience the reviewer used an even 5 per cent. as the proportion of all accidents for each day.

All of which is but to say that Dr. Rubinow has well mapped the road, and achieved valuable tentative results, but that conclusive results must await the accumulation of more adequate data. And herein lies a moral for the movement to bring about standardization and uniformity in accident and compensation statistics. It is along that way that the shortest road to adequate American experience for such a standard table, which is precisely the thing needed, lies.

LEONARD W. HATCH.

Industrial Accident Prevention. By David S. Beyer. New York, Houghton Mifflin, 1916. 421 pages.

Under the above title a new and interesting treatise in the safety field has recently been published under the authorship of Mr. David S. Beyer, manager of the accident prevention department of the Massachusetts Employees Insurance Association.

The subject is handled successively by sections or departments in the following order: General phases, building construction and arrangement, power generation and distribution, machine construction, special industries, fire hazard, explosive hazard, and personal elements.

The work is largely encyclopedical in its nature, that is, the author has evidently set himself to the task of educating the layman in regard to the needs of safety work and to acquaint him with the methods by which some of these needs have already been met. In keeping with the idea of making the book readable to the layman, who the author evidently believes would not understand working drawings or perspectives, the book is illustrated almost entirely with photographs "which carry more conviction than drawings" as the author puts it. The vast majority of the photographs are from the United States Steel Corporation and its subsidiaries. In fact, as a criticism, it may well be stated that undue emphasis has been laid on the steel industry as compared to others and in view of the fact that most of the photographs shown have already been published by the Steel Corporation in pamphlets and other forms, this criticism appears to be more justified. They are, however, accompanied by clear and concise descriptions which offer many valuable suggestions to the technical reader as well as the layman.

The photographs taken from scenes of catastrophes and accidents are sufficiently vivid to convince the most indifferent reader that

the present propaganda for "Universal Safety" is not based on any flight of imagination, but is rather the natural revulsion against the negligence of past decades which made possible such calamities as purported.

It will be regretted at least by some that the author, in his zeal to show a great number of the safety devices now used, has included many of questionable value and that in the illustration of safety practices, he has resorted to what may well be termed "negative instruction," that is, showing things as they should not be rather than confining his illustrations to conditions as they should be. The negative method of education is viewed as a dangerous one by many experts in the field today.

These features, however, will undoubtedly be excused in the minds of many on the ground that they tend to make the subject matter exceedingly readable and interesting and undoubtedly this is true in many instances.

The work as a whole is a credit to the author. It bears the stamp of care in research. It represents a great amount of work and will undoubtedly be instrumental in bringing converts to the safety movement from hitherto uninterested classes.

CARL M. HANSEN.

Wisconsin Industrial Commission. Industrial Accidents, July 1, 1912 to Dec. 31, 1914. Madison, 1915. 52 pages.

It is refreshing to find a report issued by an industrial commission which contains an analysis of the accident experience of a state without a volume of arguments and frills of one sort and another to obscure the statistical data. The Industrial Commission of Wisconsin during the period from July 1, 1912, to December 31, 1914, received notice from employers of labor in the state, excluding railroads, farmers and proprietors of establishments employing less than four persons, of 24,000 accidents which caused death, permanent injury or disability for more than one week. Recognizing the value of this considerable volume of experience, the Commission has carefully analyzed the accidents comprising it and has presented the results of its study in a clear and concise manner.

Table I, showing the number and severity of compensatable injuries reported for 1914, is particularly interesting. By reason of its duties in connection with the supervision of compensation

insurance, the Commission has been able to secure the approximate payroll of each industry "so that the number of accidents may be compared with the number of men exposed to injury." The comparison of accident statistics with exposure is a departure which makes this report of the Industrial Commission of Wisconsin decidedly different from the usual report of an industrial commission. However, the Commission has not been content with showing the number of accidents without some more definite and precise manner of measuring their gravity. It is pointed out that "the mere number of accidents, even when compared with the extent of exposure, does not give a true index of the hazard." For this reason, the Commission has used an exceedingly clever method of measuring the effect of accidental injuries which combines the number and severity of injuries in such manner that an index of the gravity of accidents in each industry is readily obtained. "For this purpose a day's time loss was selected. A death or permanent total disability evidently entails a time loss equivalent to the workman's expectancy of working life at the time of his injury. At the age of thirty, the expectancy of working life may be taken at twenty-five years, or 7,500 working days. Since the average age of workmen injured in this state is not far from thirty years, each death or permanent total disability may be taken to represent 7,500 days of lost time. A permanent partial disability represents a fraction of 7,500 days proportionate to the degree of disability. In this way is obtained an expression for the total importance (or gravity) of accidents occurring in a particular industry or due to a particular cause."

With this expression for the gravity of accidents, a true index of relative hazard can be obtained by comparing the number of days lost per one hundred thousand dollars of payroll in each industry. The absolute necessity for having exposure figures with which to compare accident statistics and the apparent uselessness of going into great detail without such figures may be best explained by the following table compiled from data taken from this report, which gives the order of the five industries that are rated highest on three different bases for measuring relative hazard:

1. *Number of Injuries:*
 1. Wood working.
 2. Metal working.

3. Public utilities and transportation.
4. Construction.
5. Food, beverages and tobacco mfg.

2. *Time Lost:*

1. Wood working.
2. Public utilities and transportation.
3. Construction.
4. Metal working.
5. Mining and quarrying.

3. *Time Lost and Payroll Exposure:*

1. Mining and quarrying.
2. Construction.
3. Public utilities and transportation.
4. Wood working.
5. Paper working.

The most reliable index of the relative hazard is that used in connection with the third part of this table, viz., the time lost per worker or per unit of payroll. If it is assumed that this index measures the relative hazard of industries in Wisconsin (and from a general knowledge of conditions in Wisconsin, this seems to be true), then methods 1 and 2, the usual methods of presenting accident statistics, produce results which are misleading and fallacious. Still, we have all reviewed compensation bulletins containing extensive charts, based upon methods of this character, and it goes without saying that these charts have been taken by uninformed persons as absolute truth.

For persons who will find it impossible to secure copies of the bulletin, the following excerpts from the explanation of other tables presented in the bulletin are given. The conclusions reached are based upon analyses of all accident reports collected by the commission from the period July 1, 1912, to June 30, 1914:

Table III presents an analysis of these accidents "by nature, severity and anatomical location of injury. As would be expected, injuries to hands and feet predominate, giving point to the slogan, 'Put your soul in your work, not your hand or foot.' Loss of fingers is by far the most frequent among dismemberments. Eyes come second in number of permanent injuries. In fractures, how-

ever, the long bones of the leg hold the leading place. A point of interest is the average duration of disability from fractures of different bones. A fracture of the hip or thigh causes an average disability of 100 days; a fracture of other leg bones of seventy-two days. A fracture of fingers or toes causes an average disability of about twenty-five days."

Table IV "shows the temporary injuries of the biennium distributed by duration of disability. It is notable that in 47 per cent. of all temporary injuries which cause disability for more than one week, the disability terminates during the second week. Another 21 per cent. of disabilities terminate during the third week and 10 per cent. during the fourth week. Stated in other terms, only 23 per cent. of all temporary disabilities extend beyond four weeks, only 9 per cent. beyond six weeks, only 2 per cent. beyond three months and only 6 per cent. beyond six months."

Table V presents the results of a study of the wages of workmen injured. "The average wages of injured workmen are \$12.90 per week, which, after allowing for periods of unemployment, would correspond very closely to average annual earnings of \$600. It is important to note that only 1 per cent. of the workmen injured were receiving less than the minimum weekly wage basis for compensation, whereas 21 per cent. were receiving more than the maximum compensation basis."

Table VI presents the results of a study of these accidents by age of injured workmen. "65 per cent. of all injured workmen are between the ages of 16 and 35, and 60 per cent. are between the ages of 20 and 40. Very few are under 16, and only 11.5 per cent. are above the age of 50. The vast majority of work injuries are to able-bodied men in the prime of life."

Table IX classifies these accidents by the number of hours worked on the day of injury. The following interesting results are indicated: "The highest number of accidents occurred during the ninth hour of work, or roughly between four and five p. m. It has long been known that the peak of accidents falls at about 11 in the forenoon, and the secondary peak between 4 and 5 in the afternoon. This table shows the same thing from a different angle: viz., the number of hours worked up to the time of the injury. If, however, it is assumed that the great majority of men begin to work at 7 in the morning, then the figures in this table correspond very closely to those collected in other states and countries

on the basis of the hour of the day at which the injury occurred. The reason for this curious accumulation of accidents in the middle of the forenoon and toward the end of the afternoon remains to be explained."

The remaining Tables X to XXIII deal with the causes of accidents. "A notable feature of these tables is the marked difference in the distribution of the causes of fatal and serious permanent, as compared with lesser injuries. The number of fatalities per hundred compensation accidents was $1\frac{1}{2}$ for all machinery taken together as compared with 5 for falling objects and $3\frac{1}{2}$ for falls of persons. Blasting caused seven fatalities and one permanent total disability out of twenty-two compensation accidents, while saws caused only six fatalities and one permanent total disability out of 824 compensation accidents. Machinery was responsible for 25 per cent. of all accidents but for only 16 per cent. of fatal accidents. Explosions caused less than 1 per cent. of all accidents but nearly 3 per cent. of fatal accidents. Falls of persons caused 10.6 per cent. of all accidents and 27.4 per cent. of fatal accidents."

As a statement of dependable facts concerning industrial accidents, their causes, results, cost and the condition of employees who suffer them, the report may be highly commended. It appeals to the statistician as a statistical compilation done in good form rather than an extensive essay on workmen's compensation interpolated here and there with a few figures drawn in an uncertain manner from the experience of a certain state. We realize the fact that there are serious problems to study; that these problems have assumed certain definite forms and that we must have dependable statistical information tabulated in a convenient manner upon which to base our studies of them. We are pleased, therefore, to find a report fashioned on the lines of this report of the Industrial Commission of Wisconsin.

G. F. MICHELbacher.

New Zealand Official Year Book, 1914, by Malcolm Frazer, Government Statistician, Wellington, New Zealand, 1914, pp. 1017.

Contains a brief abstract of principal provisions of the 1913 amendment to the Old Age Pensions Act which consolidated the Acts of 1898 and succeeding years with the Bills for Widows' and Military Pensions. In 1914, 18,050 persons were granted old-age pensions at a cost of £416,776, or an average per head of popula-

tion of 7s. 7d. Statistics of the Widows' Pensions Act of 1911 and of the Military Pensions Act of 1912 are also given.

The Superannuation Funds for public and semi-public servants of the Dominion present their principal statements of transactions to date of December 31, 1913. The experience of the National Provident Fund is given for the three years 1911-1913. The main object of this fund is to encourage voluntary thrift on the basis of mutual contributions by the State and the individual so as to provide annuities in old age. This object is supplemented, however, by other benefits for the protection of the family, from birth to old age.

Industrial insurance, also, seems to hold popular favor. From a policy in force of 30,714 in 1903, the business has grown to 80,419 policies in 1912 at a reduction in expense proportion of premium income of from 63.9 per cent. in 1903 to 46.8 per cent. in 1912. In point of premium receipts and claims paid, the Accident Department of the New Zealand Insurance Department stood fourth among the organizations transacting this class of business.

The supplement contains a mortality table for New Zealand over two periods 1901-1905 and 1906-1910 respectively. This table, compiled from 1911 census returns, gives the mortality rates by single ages for both sexes and presents figures for the expectation of life in parallel tables. In the vital statistics section, it is pointed out that New Zealand has the highest rate of natural increase of population (by excess of birth over deaths) of the principal countries of the world. Mortality in 1911, as developed by census returns, was strikingly lower at all age periods in New Zealand than in England and Wales. The difference is especially marked at the ages under 5, where the effect of the very low infant mortality is seen. Deaths from tuberculosis per unit of population, 69 per 100,000 in 1912, were fewer in New Zealand than in any subdivision of the British Empire except Queensland, Australia. Statistics are given for other causes of death. The tabulations are comparable with statistics compiled under the titles of the International List-Causes of Death, which classification has been employed in New Zealand since 1908.

EDWIN W. KOPF.

Report on the Teachers' Retirement Fund, City of New York.
Commission on Pensions, City of New York, 1915. viii + 177
pages.

This book is one which will be of great value to students of pension fund problems because of

1. The problem which is considered, namely, the rehabilitation of a bankrupt pension fund.
2. The clarity of statement throughout the report.
3. The character of actuarial work done, which was under the supervision of a volunteer committee appointed by the Actuarial Society of America, consisting of Messrs. Hutcheson, Henderson and Moir.

The report is by a commission which is considering a general pension scheme for New York City employees. The commission indicates that it would have preferred to consider the problem as a whole, but it was forced to take up the teachers' pension fund first because of its serious condition. "The fund is now living from hand to mouth; no further retirements are possible; teachers are paying one per cent. of their salaries to meet arrearages in the fund and with no assurance that when their time comes to retire provision will be made for them. Reorganization and refinancing of the fund is imperative. It must be undertaken in full view of the facts and with complete appreciation that a great retirement system cannot be maintained without straightforward, adequate financing."

The report is divided into three sections—Part I, Interpretative and Constructive Report, which, after showing a balance sheet under present conditions, discusses the present pension provision, its cost, etc., and compares it with the reserve or "Think of the Future" plan of pension fund operation; next, a tentative reorganization plan is suggested and finally there is a summary of recommendations for financing the fund requirements.

Part II is entitled "Descriptive Report" and deals with the existing fund and the machinery for its administration, the staff to which it applies, a history of its developments and some attempts at reorganization. Under the latter head it is interesting to note the fact that when, some time ago, there were indications of serious conditions a thoroughly competent actuary was called in to advise the fund, and a special committee was appointed to draw up a bill

for amendment of the retirement law. "Although the resulting constructive plan was meant only as a temporary measure of relief, it almost entirely disregarded the advice of the actuary," which unfortunately is too often the case.

Part III of the report gives in detailed and useful form the basic data of actuarial calculations. Formulæ are not given except by implication in the form of the service table, but a competent actuary familiar with pension fund methods should have no difficulty with this part of the work.

In the course of the descriptive part of the work the commission points out that there are a number of pension funds for teachers and others in various cities of the United States which are, if not in as serious a situation, rapidly approaching it. This field, therefore, is becoming of greater importance daily, and this report should be in the library of every actuary who is likely to be called upon in connection with such work.

It should be noted, as indicated on the title page, that "This report was approved for publication, for the purpose of conference and discussion, at a meeting of the Commission on Pensions, on January 5, 1916."

ALBERT H. MOWBRAY.

CURRENT NOTES.

New Feature of Labor Statistics Reports.

The report of the Kansas Department of Labor for 1914 contains what is apparently the first statement of wage *scales* for any important industry in the United States. Most labor reports contain statements of absolute wages paid, but none, so far as can be determined, have ever given the *rates* of wages. The scales relate chiefly to mining and allied occupations in the extraction of minerals.

Occupational Mortality.

The Section on Vital Statistics of the American Public Health Association has published the report of its Committee on Occupational Mortality in the January, 1916, number of the *Journal* of the American Public Health Association. In brief the committee recommends the intensive study of occupational mortality problems in local fields and gives as an example Schereschewsky's study of garment workers in New York City, Hayhurst's study of lead workers and potters in Chicago and Ohio, Tucker's investigation of cement workers in California, and other inquiries made in direct contact with local conditions. The active co-operation of vital statisticians, health officers, labor commissioners and officers of compensation boards was invited.

A Foreign Review of the Proceedings.

The following notice of the Society and its *Proceedings* has appeared in the March, 1916, p. 236, issue (Band XVI, 2. Heft) of the *Zeitschrift für die gesamte Versicherungs-Wissenschaft*, the foremost insurance periodical of Germany:

“The United States of America is probably the only country in which the development of social insurance has made perceptible progress during the period of war. Besides the numerous legislative changes which the years 1914 and 1915 have brought, an additional evidence of this development may be found in the organization of the Society, whose object is the encouragement, by meetings and publications, of the mathematical and statistical sciences and

their application to casualty and social insurance. . . . The Society is organized on principles similar to the foreign actuarial societies. The members must pass examinations for admission to membership, of which two grades are established. We are speaking here of the Casualty Actuarial and Statistical Society of America. We find among the members a large number of insurance experts well known in Germany, who have contributed studies in the field of Social Insurance. . . . The first three numbers of the *Proceedings*, which are before us, indicate that the new Society has approached the solution of the very difficult problems with a true scientific zeal and knowledge. The papers published until now deal primarily with the scientific aspects of premium and reserve computations of compensation and liability insurance, so that it has already become evident that in the transactions of the Society, Social Insurance, and primarily Social Accident Insurance, will occupy a predominant, even an exclusive, position. Extensive bibliographies are attached to each issue. . . . An examination of these issues leads to the impression that, not only German Social Insurance, but also German insurance science has acquired a strong foothold in America."

New York City Teachers' Retirement Fund.

A bill has been introduced into the New York State Legislature which has been endorsed by the Pension Commission, the Board of Education, the representatives of the school teachers, and by the Comptroller and Mayor of New York City. The plan calls for a somewhat more liberal scale of pension benefits than that suggested in the first report, but provides for equal contributions from the teachers and from the city. The present employees are to contribute a percentage of their salaries equal to one-half the cost of their pension up to a limit of 8 per cent. of their salaries, the balance being carried by the city. The liability on account of persons now on the pension roll is to be taken over by the city.

Although the contributions of the teachers now in the service are to be funded, the contributions of the city on the part of these employees are not to be funded at the outset; however, the Pension Commission recommends and the bill provides that this may be done. The city assumes the liability, and it is hoped that the fiscal authorities will appreciate the desirability of funding this liability within the next few years. In any event the increase in the fund's liability which is due to the admission of new entrants will be stopped, since the contributions of such new entrants and of the

city will both be funded. The bill provides for the maintenance of data sufficient for actuarial valuations and for the employment of an actuary who will be required to make an official valuation of the fund at stated intervals, to recommend any changes in contribution rates necessary, and who will be expected to publish an annual statement showing its present and prospective assets and liabilities.

Report of the Senate Committee on Civil Service, New York State.

This report was transmitted to the Legislature of the State of New York under date of March 27, 1916. The committee has stated the duties, qualifications and compensation of actuaries and statisticians as follows:

ACTUARY GROUP (D 2)

*Professional and Scientific Service
Actuary Group*

Definition:

The term Actuary Group is used to identify those authorized employments of the Professional and Scientific Service, the incumbents of which are required to collect, tabulate, verify, analyze and interpret actuarial data, to prepare actuarial formulae, and to give critical and constructive actuarial advice.

GRADE I (D 2 I)

TITLE OF POSITIONS—

ASSISTANT ACTUARY

DUTIES—

Definition:

The duties of incumbents of these positions are to assist in the direction and supervision of an actuarial unit of a State department charged with the collection, tabulation, verification, analysis and interpretation of actuarial data, to prepare actuarial formulae, and to give critical and constructive actuarial advice.

QUALIFICATIONS—

Persons holding these positions shall have:

1. Such training and experience in the theory and practice of the actuarial science as is evidenced by membership in an actuarial society of recognized standing.

2. Not less than four years of experience in actuarial methods and practice, requiring a thorough knowledge of higher mathematics and a practical knowledge of the Insurance Law of the State of New York, the law of contracts, agency, and other subjects of commercial practice, and the science of accounting, and a broad understanding of social and economic phenomena.

3. Such additional qualifications as may be required by the State Civil Service Commission.

COMPENSATION—

The range of annual compensation of this Grade for full time service is from \$2340 to \$3300, inclusive, with standard salary rates as follows: \$2340, \$2580, \$2820, \$3060, \$3300.

SPECIAL REGULATION GOVERNING SALARY RATES—

The entrance and other salary rates of positions classified within this Grade are conditional upon appraisal, under the rules of the State Civil Service Commission, indicating that the rates to be designated do not exceed the value of the work to be performed.

GRADE II (D 2 II)

TITLE OF POSITIONS—

ACTUARY

DUTIES—

Definition:

The duties of incumbents of these positions, which require the widest experience in actuarial work and the highest degree of specialized knowledge and skill in the actuarial science, are to direct and supervise an actuarial unit of a State department charged with the collection, tabulation, verification, analysis and interpretation of actuarial data, to prepare actuarial formulae, and to give critical and constructive actuarial advice of the highest order.

QUALIFICATIONS—

Persons holding these positions shall have:

1. The minimum qualifications prescribed for Grade I.
2. Not less than three years of service in Grade I, or if

appointed otherwise than by promotion from Grade I, at least three years of experience in work of Grade I character and standard.

3. Such additional qualifications as may be required by the State Civil Service Commission.

COMPENSATION—

The annual compensation of this Grade for full time service is \$3600 and up.

SPECIAL REGULATION GOVERNING SALARY RATES—

The entrance and other salary rates of positions classified within this Grade are conditional upon appraisal, under the rules of the State Civil Service Commission, indicating that the rates to be designated do not exceed the value of the work to be performed.

STATISTICIAN GROUP (D 23)

*Professional and Scientific Service
Statistician Group*

Definition:

The term Statistician Group is used to identify those authorized employments of the Professional and Scientific Service, the incumbents of which are required to collect, collate, analyze and interpret numerical data, relating to economic, social or other phenomena, as a basis for administrative guidance or regulative control.

GRADE I (D 23 I)

TITLE OF POSITIONS—

JUNIOR STATISTICIAN

DUTIES—

Definition:

The duties of incumbents of these positions, which require familiarity with statistical methods or actuarial formulæ, are to collect, collate, analyze and interpret, under supervision, numerical data relating to economic, social or other phenomena, as a basis for administrative guidance or regulative control.

QUALIFICATIONS—

Persons holding these positions shall have:

1. Such training in economic or social research and in the technique of statistics as is evidenced by a degree, diploma or certificate granted on completion of a standard course of instruction including the above branches of study, in a college of recognized standing, or proof of other training in economic or social research and in the technique of statistics recognized by the State Civil Service Commission as the equivalent thereof; *or*
2. Not less than two years of practical experience in statistical methods and practice.
3. Such additional qualifications as may be required by the State Civil Service Commission.

COMPENSATION—

The range of annual compensation of this Grade for full time service is from \$1080 to \$1560, inclusive, with standard salary rates as follows: \$1080, \$1200, \$1320, \$1440, \$1560.

GRADE II (D 23 II)

TITLE OF POSITIONS—

STATISTICIAN

DUTIES—

Definition:

The duties of incumbents of these positions, which may involve supervision of statistical units of State government and which require ability to plan statistical inquiries and to devise classifications and forms therefor, are to conduct independently, important statistical investigations and to prepare interpretative reports thereon.

QUALIFICATIONS—

Persons holding these positions shall have:

1. The minimum qualifications prescribed for Grade I.
2. Not less than two years of service in Grade I, or if appointed otherwise than by promotion from Grade I, at least three years of experience in work of Grade I character and standard.

3. Such additional qualifications as may be required by the State Civil Service Commission.

COMPENSATION—

The range of annual compensation of this Grade for full time service is from \$1680 to \$2820, inclusive, with standard salary rates as follows: \$1680, \$1800, \$1980, \$2160, \$2340, \$2580, \$2820.

SPECIAL REGULATION GOVERNING SALARY RATES—

The entrance and other salary rates of positions classified within this Grade are conditional upon appraisal, under the rules of the State Civil Service Commission, indicating that the rates to be designated do not exceed the value of the work to be performed.

GRADE III (D 23 III)

TITLES OF POSITIONS—

CHIEF STATISTICIAN

SENIOR STATISTICIAN

DUTIES—

Definition:

The duties of incumbents of these positions, which require the widest experience in statistical work and the highest degree of specialized knowledge and skill in the science of statistics, are to assume complete responsibility for the control and direction of the most important inquiries of a statistical nature; to supervise large statistical units; or to give critical and constructive statistical advice of the highest order.

QUALIFICATIONS—

Persons holding these positions shall have:

1. The minimum qualifications prescribed for Grade II.
2. Not less than three years of service in Grade II, or if appointed otherwise than by promotion from Grade II, at least four years of experience in work of Grade II character and standard.
3. Such additional qualifications as may be required by the State Civil Service Commission.

COMPENSATION—

CHIEF STATISTICIAN

The range of annual compensation of this position in this Grade for full time service is from \$3060 to \$6000, inclusive, with standard salary rates as follows: \$3060, \$3300, \$3600, \$3900, \$4200, \$4500, \$4800, \$5100, \$5400, \$5700, \$6000.

SENIOR STATISTICIAN

The range of annual compensation of this position in this Grade is from \$3060 to \$3900, inclusive, with standard salary rates as follows: \$3060, \$3300, \$3600, \$3900.

SPECIAL REGULATION GOVERNING SALARY RATES—

The entrance and other salary rates of positions classified within this Grade are conditional upon appraisal, under the rules of the State Civil Service Commission, indicating that the rates to be designated do not exceed the value of the work to be performed.

F. Spencer Baldwin has a paper entitled "Advantages and Disadvantages of State Funds in Workmen's Compensation" in the March, 1916, number (Publication 32) of the *American Labor Legislation Review*. (131 E. 23d St., New York, \$1.)

Donald A. Baxter, assistant actuary of the Michigan Insurance Department, has been appointed assistant deputy insurance commissioner of Michigan.

Frederick L. Hoffman has a paper entitled "Occupational Hazards in the American Merchant Marine" in the March, 1916, number (Publication 32) of the *American Labor Legislation Review*.

W. S. Moore, formerly secretary of the Kansas Casualty & Surety Co., is now with the Guarantee Bonding & Ins. Co. of Wichita, Kan., as secretary-treasurer.

Albert H. Mowbray has become the secretary of the Massachusetts Employees Ins. Assn., which office he fills in addition to that of actuary, which he has held for several years.

Robert K. Orr has resigned as manager of the Michigan State Accident Fund to become secretary and general manager of the Michigan Employers Casualty Co.

I. M. Rubinow has resigned as chief statistician of the Ocean Accident and Guarantee Corporation to become the secretary of the

Social Insurance Committee of the American Medical Association. He will, however, remain in the profession as a consulting actuary and statistician. He has "A Defense of the Standard Accident Table" in the *American Economic Review*, Vol. VI, No. 1 (March, 1916), p. 250. This article is in reply to Professor Willard C. Fisher's review of the Standard Accident Table in the *American Economic Review*, Vol. V, No. 4 (Dec., 1915), p. 903. Henry Holt & Co. announce the early publication of his book on "Standards of Health Insurance," which has been expanded from articles printed in the *Journal of Political Economy* for March, April and May, 1915.

Claude E. Scattergood has an article entitled "The Synthesis of Rates for Workmen's Compensation" in the January 8, 1916, number of the *Economic World*. Reprints may be obtained free upon application to the author.

The Examination Committee has issued a pamphlet entitled "Recommendations for Study in Connection with the Examinations of the Casualty Actuarial and Statistical Society of America." Copies may be obtained upon application to the Secretary of the Society.

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

THE CASUALTY ACTUARIAL AND STATISTICAL SOCIETY OF AMERICA.

THE COUNCIL.

Officers: I. M. RUBINOW *President*
ALBERT H. MOWBRAY *Vice-President*
BENEDICT D. FLYNN *Vice-President*
CLAUDE E. SCATTERGOOD *Secretary-Treasurer*
RICHARD FONDILLER *Editor-Librarian*

Term Expires
Elected: FREDERICK L. HOFFMAN October, 1916
ALBERT W. WHITNEY October, 1916
HARWOOD E. RYAN October, 1917
JOSEPH H. WOODWARD October, 1917

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HARWOOD E. RYAN

W. N. MAGOUN

C. E. SCATTERGOOD

MEMBERSHIP OF THE SOCIETY, FEBRUARY 25, 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, Office of A. E. Ames & Co., Toronto, Ont.
	† Breiby, William, Office of Fackler & Fackler, Consulting Actuaries, 35 Nassau St., New York.
	† Brodin, Richard, Office of Miles M. Dawson, Consulting Actuary, 141 Broadway, New York.
Oct. 22, 1915	Brown, Herbert D., Chief of 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.
	† 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.

- † 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, A. H., Workmen's Compensation Service Bureau, 18 East 41st St., 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.
- † 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., 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, 133 William St., New York.
- † Downey, E. H., Special Deputy Insurance Commissioner, 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., 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, Equitable Life Assurance Society, 120 Broadway, New York.
	†	Fitch, Frank M., Auditor, Hartford Steam Boiler & Inspection 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, 133 William St., 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, 149 Broadway, New York.
	†	Furze, Harry, Comptroller, Globe Indemnity Co., 45 William St., New York.
Feb. 19, 1915		Garrison, Fred S., Superintendent, Burglary and Plate Glass Department, Travelers Indemnity Co., Hartford, Conn.
	†	Gaty, Theodore E., 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., Statistician, Travelers Ins. Co., Hartford, Conn.
	†	Gould, William H., Secretary-Actuary, Jos. Froggatt & Co., 149 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., Actuary & 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., Secretary, Accident Prevention Department, Workmen's Compensation Service Bureau, 18 East 41st St., New York.
- Oct. 22, 1915 Hatch, Leonard W., Chief Statistician, State Industrial Commission, Albany, N. Y.
- Oct. 22, 1915 Hess, Herbert, Statistician, Massachusetts Bonding & Ins. Co., Boston, Mass.
- † 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., General Manager, Massachusetts Rating and Inspection Bureau, Boston, Mass.
- † 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 & 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., 35 Nassau St., New York.
- May 19, 1915 Johnson, William C., Equitable Bldg., Equitable Life Assurance Society, Boston, Mass.
- Oct. 22, 1915 Kime, Virgil M., Actuary, American Central Life Ins. Co., Indianapolis, Ind.
- † King, Walter I., Actuary, Columbian National Life Ins. Co., Boston, Mass.
- † Kopf, Edwin W., 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, 425 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 Mayerink, Emma C., New York Ins. Dept., 165 Broadway, New York.
- Feb. 19, 1915 Mead, Franklin B., Secretary & Actuary, Lincoln National Life Ins. Co., Fort Wayne, Ind.
- Oct. 22, 1915 Meeker, Royal, Commissioner, Bureau of Labor Statistics, U. S. Dept. of Labor, Washington, D. C.
- † Michelbacher, G. F., Statistician, Workmen's Compensation Service Bureau, 18 East 41st St., New York.
- † Miller, David W., 354 New York Ave., Brooklyn, N. Y.
- † Milligan, Samuel, Metropolitan Life Ins. Co., 1 Madison Ave., New York.
- † Mitchell, J. F., Secretary, Maryland Casualty Co., Baltimore, Md.
- † 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, La Sul America, Rio-de-Janeiro, Brazil.
- † Orr, Robert K., Secretary and General Manager, Michigan Employers Casualty Co., Lansing, Mich.
- † Otis, Stanley L., Actuary, Workmen's Compensation Service Bureau, 18 East 41st St., New York.
- † Pallay, Julius J., Statistician, London Guarantee & Accident Co., Ltd., 134 So. La Salle St., Chicago, Ill.
- † 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 & 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-General Manager, Utica Mutual Compensation Ins. Corp., 110 Genesee St., Utica, New York.
	†	Whitney, Albert W., General Manager, Workmen's Compensation Service Bureau, 18 East 41st St., 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.

Date Enrolled		
Oct. 22, 1915		Baxter, Don. A., Assistant Deputy Ins. Commissioner, Michigan Ins. Dept., Lansing, Mich.
Oct. 22, 1915		Brann, Ralph M., Assistant Manager, State Compensation Ins. Fund, Denver, Col.
Oct. 22, 1915		Brockway, U. H., Travelers Ins. Co., Hartford, Conn.
Oct. 22, 1915		Buffer, 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. 22, 1915		McGuire, Vincent G., State Industrial Commission, 230 Fifth Ave., New York.
Oct. 22, 1915		Müller, Fritz, New York Life Ins. Co., 346 Broadway, New York.
Oct. 22, 1915		Tilson, Howard, Manager, Illinois Division, Accident Prevention Dept., Workmen's Compensation Service Bureau, Insurance Exchange, Chicago, Ill.

- Oct. 22, 1915 Van Tuyl, Hiram O., Assistant Examiner, New York Ins. Dept., 165 Broadway, New York.
- 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.

DECEASED FELLOWS.

Date of Death

- Aug. 20, 1915 Montgomery, William J., State Actuary, Boston, Mass. (Admitted Feb. 19, 1915)
- July 24, 1915 Phelps, Edward B., Editor, The American Underwriter, New York. (Charter Member)

SCHEDULE OF MEMBERSHIP, FEBRUARY 25, 1916.

	Fellows.	Associates.	Total.
Membership, October 22, 1915.....	134	13	147
By withdrawal.....	4	—	4
	130	13	143
Addition:			
By Election—Feb. 25, 1916.....	5	—	5
Membership, February 25, 1916.....	135	13	148

ABSTRACT FROM THE MINUTES OF THE MEETING,
FEBRUARY 25, 1916.

The fifth regular meeting of the Casualty Actuarial and Statistical Society of America was held at the Hotel Astor, New York City, on February 25, 1916.

President Rubinow called the meeting to order at 10:15 A.M. The roll was called, showing the following thirty-seven Fellows and six Associates present:

FELLOWS.

CAMMACK	HANSEN	MULLANEY
CRAIG, J. D.	HESS	NICHOLAS
DEKAY	HUGHES	ORR
DUBLIN	KING	OTIS
EGBERT	KOPF	RUBINOW
FARRER	LUBIN	RYAN
FISHER	MADRILL	SCATTERGOOD
FLYNN	MAGOUN	SCHETLIN
FONDILLER	MICHELbacher	WHITNEY
GARRISON	MILLER	WOLFE, L. J.
GOULD	MILLIGAN	WOODWARD, J. H.
GRAHAM, T. B.	MOORE, G. D.	
GRAHAM, W. J.	MOWBRAY	

ASSOCIATES.

BROCKWAY	LEVY	VAN TUYL
BUFFLER	MÜLLER	WILLIAMSON

Messrs. A. Bernstein, Floyd F. Brown, E. S. Cogswell, M. Meltzer and C. H. Waterbury were present as guests of the Society.

The minutes of the meeting held October 22 and 23, 1915, were approved as printed in the *Proceedings*.

The Council reported affirmative action as follows:

The authors of articles shall be charged at cost for their reprints in the future and the free supply of such reprints shall be discontinued.

All numbers of the *Proceedings* shall be sold at half price to new members and students who have enrolled to take the examinations of the Society.

A selected list of American universities having insurance courses shall be placed upon the complimentary list for the receipt of the *Proceedings* in the future.

It was moved and carried that the report of the Council be adopted by the Society.

The President presented a resolution, which was adopted, to the effect that he be authorized to arrange, if possible, with Columbia University to have courses in casualty insurance established there, in order to assist students to prepare for the examinations of the Society.

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

Close, Charles, L., Manager, Bureau of Safety, U. S. Steel Corporation, 71 Broadway, New York.

Fay, Albert H., Statistician, U. S. Bureau of Mines, Washington, D. C.

Froggatt, Joseph, President, Joseph Froggatt & Co., Insurance Accountants, 149 Broadway, New York.

Jackson, Charles W., Actuary, Postal Life Ins. Co., 35 Nassau St., New York.

Strong, Wendell M., Associate Actuary, Mutual Life Ins. Co., 32 Nassau St., New York.

After ballot, these nominees were declared duly elected Fellows.

The reports of the Treasurer and the Editor were read and accepted.

The papers printed in this number were read or presented.

Luncheon was served at the Hotel Astor during the noon recess.

The Society reconvened at 2.00 P.M., with Vice-President Mowbray in the chair.

The reading and presentation of papers was resumed and the papers appearing in previous numbers of the *Proceedings* were discussed.

Upon motion, the meeting adjourned at 5.30 P.M.

CONSTITUTION.

ADOPTED FEBRUARY 19, 1915.

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, and an Editor-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.

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-Librarian 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 Editor-Librarian shall also, 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 1916.* Examinations will be regularly held in May, 1916, 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 1917, 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.
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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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SCHEDULE RATING CONSIDERED FROM AN ACTUARIAL POINT OF VIEW. Albert H. Mowbray.
NOTES ON THE THEORY OF SCHEDULE RATING. Albert W. Whitney.
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NOTE ON THE APPLICATION OF RECENT MATHEMATICAL-STATISTICAL METHODS TO COAL MINE ACCIDENTS, WITH SPECIAL REFERENCE TO CATASTROPHES IN COAL MINES IN THE UNITED STATES. Arne Fisher.
BURGLARY INSURANCE STATISTICS. Fred S. Garrison.
A SYSTEM OF ANALYZING WORKMEN'S COMPENSATION BUSINESS BY MEANS OF PERFORATED CARDS. Edmund E. Cammack.
TABLES FOR COMPUTING THE PRESENT VALUE OF DEATH BENEFITS ARISING UNDER THE NEW YORK WORKMEN'S COMPENSATION LAW. Richard Foddiller.
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VOLUME II, PART III

NUMBER 6

PROCEEDINGS
OF
The Casualty
Actuarial and Statistical
Society of America

MAY 26 and 27, 1916

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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.



MEMBERS PRESENT AT THE SIXTH MEETING OF THE SOCIETY. (SEE PAGE 488.)

PROCEEDINGS

MAY 26 AND 27, 1916.

THE RELATION BETWEEN PRIVATE AND SOCIAL
INSURANCE.

PRESIDENTIAL ADDRESS.

BY

I. M. RUBINOW.

For several reasons this meeting, the sixth in the history of the Casualty Actuarial and Statistical Society, has a special significance to your President. He shares with the entire Society the satisfaction of meeting for the first time outside the city and state of New York, thus emphasizing the national character of our organization. But outside of that, it is the first meeting at which he appears after the somewhat radical change in his professional affiliations. In my last presidential address before the second annual meeting last October I said: "In the natural course, the personal affiliations and business connections of your President and other officers must necessarily vary and change, but it would be very unfortunate if these purely accidental circumstances were taken into consideration in selecting them." I little thought at the time that the statement was almost prophetic and that it would be realized even before the next annual election of your officers; though in the light of events which transpired the suspicion might be justified that I was in possession of inside information.

And finally, though this is not our annual meeting, and I remain the fortunate incumbent of the highest office our profession can confer for another five months, it is, I regret to say, our last meeting at which I shall have the privilege of presiding. When you meet again I will be at the other end of the continent, and though I am determined, with the same bulldog-like tenacity, which in the

opinion of some has characterized all my conduct for the last five years, to hold on to the very end, the cold fact is that my "administration" of the affairs of the Society must come to an end very soon, and inevitably what I say to-day must bear the character of a valedictory address or a "swan's song," if you will. By a very generous provision of the constitution, your President preserves a life seat in the Council of the Society—a privilege of no small moral value, I assure you. Another constitutional provision is that the President shall not be eligible for the same office for more than two consecutive years. This is not only a very wise provision but a particularly fortunate one for your President, for it relieves him from the awkward choice of either withdrawing under fire, or facing an ignominious defeat.

Under the circumstances, the wise, the tactful thing to say and to do, would probably be to say and to do nothing. But I fear, and a good many other people fear, that tact is not my most conspicuous virtue. Nor is it easy for me, as most of you know, to say nothing when I still possess the constitutional privilege of unlimited free speech. And though this is my last appearance as President, I recognize that the second year of the Society's activity is only half over, and it would be too early and not altogether fair to try at this time to sum up the results of our activity since our organization. Perhaps that had better be left for the next meeting, which I hope to be able to address through a written communication. At this time I think it necessary to analyze the problem which is bound to present itself to our Society sooner or later, and which my personal change in business relations emphasizes rather forcibly; the problem of "the relation between private and social insurance."

At the last meeting in February, 1916, I had the privilege of *delivering a paper* on a technical problem—of compensation for permanent partial disabilities, with our Vice-President, Mr. Mowbray, in the chair. Mr. Mowbray at the time pointed out that in relinquishing the chair for the purpose of reading the paper, and thus making it subject to discussions from which presidential addresses are exempt, I displayed an unusual degree of modesty. Perhaps Mr. Mowbray was right, if the word "unusual" was intended to apply to me personally. This, however, is a presidential address with all the unfair advantages of an immunity bath. It may seem to some wiser not to make its subject open to acrimonious discussions. Personally I do not think so, and would gladly welcome a lively interchange of opinions. The wider the range of differences

disclosed the merrier, in my opinion, would be the discussion. I well remember the provision of Article II that "the Society shall take no partisan attitude, by resolution or otherwise, upon any question relating to casualty or social insurance," and further, the careful statement appearing in each number of the *Proceedings* that "the Society is not responsible for statements made or opinions expressed in the articles, criticisms and discussions." It is evident, therefore, that even in a presidential address I alone am responsible for anything I may say. On several previous occasions I have already argued for unlimited freedom of individual expressions notwithstanding these very careful and necessary provisions, or rather, for the very reason that they exist. There is, however, one additional consideration. It was quite proper, nay, even necessary, to exercise extreme care in avoiding delicate controversial problems in the early history of our organization. The Society was then in its experimental stage. However obvious its usefulness to the actuarial and statistical professions, its usefulness to the insurance business had to be proven. It was a matter of recorded history that earlier efforts at a similar organization only five years ago did not meet with favor from the powers that be in the insurance world. The interests of the cause as well as the personal safety of the members demanded a high degree of discretion, which at times amounted almost to sidestepping.

That time has fortunately passed. Moreover, it has passed much sooner than could reasonably be expected.

The wisdom of the President in reading into each one of his presidential addresses a paraphrase of the declaration of independence was questioned by some, and perhaps from the point of view of his personal interests these doubting Thomases were right. But your President takes legitimate pride in believing that his occasionally revolutionary utterances (perhaps like all revolutionary utterances) were productive of some social good. He is tempted to think that the reading of the declaration of independence by the party of the first part often prevents the reading of the riot act by the party of the second part to the social compact. In less than two years the C. A. S. S. A. has grown to be one of the most important, one of the strongest insurance organizations in the country, if not in the world. And if those aspects of insurance be considered, in regard to which American public opinion of to-day, and still more the public opinion of to-morrow, shows the greatest concern, then it may be no exaggeration to say that our Society promises to be-

come the most important insurance organization in the country. The writing on the wall is so plain that even he who runs may read—that problems of mass insurance are going to be the most important insurance problems of the next ten years, and unless I am very much mistaken, mass insurance must largely mean social insurance. These problems we simply cannot avoid. We cannot avoid them, for no intelligent body of American citizens can avoid them. We cannot avoid them, for naturally the public must look to us if not for guidance then at least for advice and intelligent discussion. And finally, we should not disregard them because we are directly and professionally concerned.

To begin with, what is social insurance? It is a question which I had to face for some years because of my literary activity, and which becomes now very much more frequent in view of my professional activity.

Definitions are proverbially difficult, particularly definitions of abstract terms which stand for concepts in the making. There are two methods of approaching any problem of definition, which might be described as the legal and the scientific method. A legal enactment may arbitrarily define any word "for the purposes of this act" to mean so and so. This method might be applied to social insurance, but it is not a very useful way of interpreting a growing social institution. The scientist examines carefully the various objects and endeavors to isolate the specific important characteristics. Supposing you were asked to define a fish. The inductive scientific method would be to examine a large variety of so-called fishes and thus arrive at a conclusion as to what general characteristics apply to a catfish, a shark, a bass, a goldfish, and perhaps a whale and a seal, that go to build the concept of fish. Surely not size nor weight, nor residence in a certain state, nor color, nor previous condition of servitude. There is something common in their shape, but if you are not satisfied by external appearances and want to investigate a little deeper, you might find if you are perspicacious enough that both a whale and a seal are only make-believe fishes after all, and that an ass in a lion's skin is an ass nevertheless.

Of course, you will understand that this is only an example and not an implication. But what sort of a fish is social insurance? There is the first chapter of my book, twelve pages long, as an effort to answer this question, or perhaps to avoid a specific answer to it.

Is social insurance necessarily state insurance, as some insist?

Even a superficial study of the social insurance movement and

literature will show the inaccuracy of such a definition. The voluntary mutual sickness and other benefit funds of Denmark or France or the unemployment funds of Belgium are as legitimately parts of social insurance as the state insurance funds of the various American states. Moreover, Italy and some South American countries have monopolized life insurance and they may sell it at cost, or may endeavor to make a profit out of it, and the bare fact of state administration would not entitle it to a place in the social insurance movement, unless together with state administration there went some organized effort to bring cheap insurance within the means of the classes.

Shall the elimination of profits be the decisive feature? Or perhaps it might be more accurate to say "the elimination of any effort at profits"? For one knows of many an insurance institution making no profits, that no one would even suspect of social insurance tendencies. Even this definition raises serious difficulties. Profits take the form of either surplus or dividends (not to speak of certain salaries that savor strongly of profits). Even admittedly social insurance carriers are not prohibited, in fact often required to build up a special emergency surplus. And if elimination of dividends be decided upon, we shall suddenly find that we have been practicing social insurance in both life and fire insurance for over half a century without knowing it, as Moliere's famous hero who spoke prose for forty years without knowing it, and that most of the giant old-line life insurance companies are social insurance carriers.

Of course, such interpretation would make social insurance quite respectable, but I doubt whether it would be accepted by many students, or would be very helpful in solving our problem.

Shall it be the object or class of people insured? One must not forget that "social insurance" grew out of "workingmen's insurance." *Arbeiterversicherung* only recently became *Sozialversicherung*. There is a very close approach to the true definition, but nevertheless it has its very serious dangers. Our own industrial life insurance companies have recently mutualized; but the Prudential Life Insurance Company of England still continues to pay out millions of dollars annually in dividends. Is the English Prudential a part and parcel of social insurance? Moreover, its business is not limited to the working class; and it is interesting to note that in Germany, where organized labor has attempted recently to establish its own industrial life insurance company with elimination of dividends and under democratic control, they call it *Volksversicherung*

(people's insurance) rather than *Sozialversicherung*. On the other hand we have the large number of industrial accident and health insurance companies, the social results of whose activities has been made the subject of a very careful investigation by the insurance departments of this country, and which admittedly cannot return to the insured much more than 40 per cent. of the premiums. If we were to include this form under social insurance I very much fear that the term would become altogether meaningless.

In a recent address on Social Insurance our genial friend and member, Mr. William J. Graham, says that "social insurance is a vague term. It has been described to mean insurance at the other fellow's expense." It is true that a sharing in the cost by other persons than the insured is a frequent characteristic of social insurance. But it is not universally so, for in early stages of its development experiments in granting insurance at cost were made, and though they were not highly successful, the place of those experiments in the history of social insurance cannot be denied. Even a recent compulsory health insurance act of Holland places the entire burden upon the insured wage worker, but it is a social insurance act (perhaps not a very satisfactory one) nevertheless. Furthermore, we are prone to forget that most life insurance is insurance at the other fellow's expense, for surely the insured person (which should mean the person receiving the indemnity in case of loss), is not at all the man named in the policy, but his wife or children or other beneficiaries, and the premiums are paid by "the other fellow" who happens to be the husband and father.

Finally, perhaps the most significant of many social insurance institutions is their compulsory character. At this moment I cannot think of any examples of application of the compulsory principle outside of social insurance. It may therefore be a very decisive symptom for our diagnosis. But needless to say, it is not a universal one. Myself a convinced, perhaps a fanatical advocate of the compulsory principle, I still must recognize that it represents but one phase, and that it is still absent in many countries and various branches of social insurance.

I have purposely enumerated all these divergent views before endeavoring to construct a definition, so as to emphasize the difficulty, nay the impossibility of framing a brief definition based upon one very striking feature. How great this difficulty is, perhaps our attitude to compensation insurance demonstrates. When the term "social insurance" was included in our constitution, it was done

largely with the view to the indefinite future. Most of our membership are unconscious of any serious discussion of social insurance having taken place as yet in our deliberations. But observe what the most important German insurance magazine, the *Zeitschrift für die gesamte Versicherungs-Wissenschaft*, has to say in a very sympathetic review of our activities: "It has already become evident that in the transactions of the Society, social insurance, and primarily social accident insurance, will occupy a predominant, even an exclusive, position." (Band XVI, 2. Heft; *Proceedings*, Vol. II, p. 307.)

There is much in a viewpoint, therefore; what shall our viewpoint be?

I have tried to prove that it is difficult to isolate any one universally present characteristic of social insurance. It does not follow that the concept is meaningless, but only that it is still in the making. As is frequently done in problems of scientific classification, the whole picture rather than one symptom must be taken, though from that picture now one, now another sign may be absent.

Provisionally "social insurance" may and must be defined. It is dealing with insurance of the large masses whose income is derived from services rather than from possession of property; whose economic status is so uncertain that the existence of the insurance provision becomes a matter of concern to the whole social structure, and only when such concern expresses itself in a distinct social policy. Mere elimination of profit through voluntary effort of the insured does not constitute social insurance; for this another term, "mutual insurance," has long existed. And nothing would be gained by substituting the word "social" for "mutual." Though there may be objections to this definition from fraternal and similar organizations, I prefer to define social insurance, for the present, at least, as the insurance of masses encouraged and stimulated or established through the instrumentality of organized society for the purpose of combatting the causes of destitution. I know that this definition may be criticized, like any other definition. But let us accept it for the present. What shall be the relation between this form of insurance and the older forms more familiar to the American public?

For a proper approach to this problem it is necessary to agree to certain facts of the past and present and possibly also to certain evident tendencies of the near future.

What is altogether clear to me is that this country stands com-

mitted to a policy of social insurance. It is unnecessary to recite here the well-known steps taken in the past, and being taken at present. But one must be blind to the whole tone of American life to fail to see what is coming. The agitation for health insurance at present, for instance, is very much stronger and goes on at a greater speed than the agitation for compensation seven years ago. It was perhaps excusable for the insurance profession not to recognize the strength of the compensation movement seven years ago, but no such excuse exists now. The movement must go on, not because there are a few "social workers" who advocate it; not because socialists advocate it, but because there exists the spirit of the new American democracy which will not permit the fear and anguish of destitution to stare in the face of millions of our citizens forever, and because the insurance method has been recognized as an effective weapon to combat it. What better evidence do we need of the approval of the principle of insurance by organized society than these concerted efforts for social insurance?

Now, if we begin with a system of exclusively private insurance, and a system of social insurance is gradually in the making, a certain encroachment of social upon private insurance is possible. I use the word "possible" deliberately. It is not inevitable, because the main function of social insurance is to create new insurance protection which has not existed before. It is, of course, a matter of common knowledge that even thirty years of social insurance in Germany has not abolished private insurance. Some of you may think that in announcing this doctrine I play false to my radical political beliefs and party affiliations. This is no place to discuss them at length. Whatever my beliefs in an ultimate cooperative commonwealth may be, it is not a problem for immediate decision at the polls, and as a practical man I may prefer to leave to the future generation the solution of the problems that will confront them. It must, therefore, be admitted that there is what may be called a natural field for private insurance and a natural field for social insurance. And there may also be a twilight zone.

The geographic boundaries between these zones must necessarily be a subject of some discussion if not contention. The claim is made that private insurance has vested rights in the premises which are so extensive and comprehensive that no encroachment upon them is permissible. That is the first serious problem that must be carefully considered.

As against this claim it must be pointed out that social insurance creates an enormous additional body of insurance. In the case of unemployment and old age insurance the entire field would be practically new. Surely vested rights cannot extend to them. In case of health insurance, perhaps 90 and surely 80 per cent. of the insurance would be entirely new. Even in compensation insurance the volume is perhaps three times as large as that of employers' liability displaced. Surely no constitutional court of high jurisdiction would give such a broad interpretation to this claim of vested rights. Even the rights under perpetual franchises are necessarily strictly limited to the explicit terms of the original grant. Some other basis for the geographic limits must be found besides the theory of vested rights.

But how about the actual threatened encroachment of social insurance upon the domain of private insurance? Let us examine the problem frankly in an impartial scientific spirit. The grievance of private insurance must necessarily be based upon the existing source of profits which may be destroyed. Modern economic society is based upon a system of profits. Whatever our ultimate ideal may be, the system of profits will persist for some time. But, after all, in economic theory as well as in political life, the justification for the persistence of profits is gradually shifting. The principle of legitimate profits is not a figment of a revolutionary brain. It is an admission that profits must be justified by service. Time was when the argument was sufficient: "This is our private business; society will please keep off the grounds." But at present the trenches around private enterprises must be built of entirely different material. When the cloak manufacturers of New York declared in the recent strike that they "were the masters of their shops and would brook no interference," there was an outburst of indignation from the progressive elements of society. It becomes necessary to prove that the profits are legitimate, not exorbitant, and a fair reward for the enterprise and ability of management, and, above all, that they are not socially undesirable. Bridges, highways, schools, all might be made very productive sources of profit. But society has ruled that these facilities be furnished without profit to anybody and it would be useless to oppose that decision.

It is almost inevitable that the element of profits will be eliminated out of social insurance in most of its branches. Compensa-

tion insurance may be pointed out as an exception. I have no desire to enter into the discussion of this problem, so interestingly handled by two distinguished members of this Society, Mr. Baldwin and Mr. Rowe. But I shall call your attention to two or three specific considerations.

1. The entire cost of compensation (if not of the industrial injuries) falls upon the employers, who are themselves in the business of making profits, and it may appear perfectly proper that they share part of that profit with the insurance organization in return for a specific service rendered.

2. Notwithstanding that, most states have made special provision for making mutual insurance easier; and that of course means insurance with the elimination of the element of profits.

3. A number of states found it necessary to provide for either competitive or monopolistic state compensation insurance.

It is, I think, entirely proper to admit that the question of the best organization of compensation insurance is still before the American people. No final decision has as yet been reached. Whether the state or community shall undertake to operate this branch of insurance will depend upon many facts and considerations. One of them probably is to admit the principle of only fair or legitimate profits in this field, and in this respect the final answer depends upon the private insurance carriers as much as upon any other interests involved. There is, as we know, a tendency to deny the necessity of limitation of profits in compensation among some casualty men. Speaking as a casualty man that was, I cannot think of any tendency that is so sure of taking compensation entirely out of the hands of casualty companies.

The year 1914 may have been a banner year for compensation profits. But the repetition of such a year would be certain to result in a very rapid increase of both state and mutual insurance.

But there is after all another consideration—perhaps of very much larger import. In so far as any private insurance company has approached the field of social insurance if not the method—the large industrial life insurance companies have done so. The most significant fact in the recent development of American insurance is the mutualization of the two giants of industrial life insurance; with this mutualization accomplished the elements of profits have been abandoned in perhaps 95 per cent. of the volume of this form of insurance. With such facts before us, the literary attack upon

the mutual insurance principle which some obstinate men still continue to indulge in, must appear altogether puerile. And the implications of this development are even wider—they show that at least in certain branches of insurance the necessity of profits as a form of payment for services rendered has altogether vanished.

The insurance business, as a business, may doggedly refuse to admit the import of these facts. The insurance profession, as a scientific profession, cannot.

On the other extreme of the insurance field we find several distinct territories over which social insurance shows no desire to encroach. There is, first of all, the very wide field of property insurance, fire, marine, burglary, plate-glass and the like. The transactions here clearly belong to the domain of transactions of business. Only indirectly if at all do some branches of it concern themselves with the problem of human destitution. It is true that even within these branches of insurance the problem of state and mutual competition has arisen. But unless the term of social insurance be made so broad as to become useless, we are dealing then with an entirely different problem. Whatever the merits of the controversy—and this is altogether outside of our present enquiry—it has not arisen out of any theoretical opposition to private business as such, but because of objection, whether based upon sound reasons or not—to certain methods of private business, and the belief—whether sound or not—that the insurance business fails to recognize the principle of reasonable profits. There is also the domain of life insurance and other forms of personal insurance for the well-to-do, including often the same form of protection which social insurance is dealing with, such as accident, health and even old age insurance. There is no concerted movement at present to encroach upon that—though there may be some criticism to what is considered an excessive expense ratio.

Let us sum up in a few definite statements the argument, which I fear has grown somewhat diffuse.

1. All insurance business partakes of the nature of semi-public service to which the principle of competitive unlimited profits does not apply. There is a growing demand for a limitation of profits to a reasonable level.

2. Insurance being in its essence an arrangement for mutual protection, the gradual extension of the mutual principle is inevitable.

3. Social insurance is, however, more than simply mutual insurance. It is insurance for the masses, in which organized society feels a direct concern, because of the hope of eliminating destitution through it.

4. Social insurance largely creates its own business; it does not to any extent encroach upon any vested interests. In so far as it does, it is an inevitable conflict between private interests and social welfare, for which conflict only one result is socially possible.

5. In so far and so long as private enterprise and private investment may persist in the insurance field, it is contingent upon efficient service and the limitation of profits to the social valuation placed upon such service.

6. Private insurance has little to gain and a good deal to lose from an over-emphasis of possible antagonism and over-claims for its vested rights.

When these conditions are frankly recognized, co-operation between the two branches of insurance may remain possible for an indefinite time.

For in insurance, as in other public utilities, the principle of service must necessarily rise above the old principle of private gain. The struggle, if there must be a struggle, will be eventually settled by experiments rather than argument. The people may be trusted to retain these old forms of organization, or create such new ones as will best conform to this conception of service and at the smallest cost. And finally, the actuarial profession as such can afford to remain neutral, at least so far as the essential principle is concerned. If profits are recognized as a necessary element of the rate, the actuary will include profits. But he does not cease to be a scientific actuary, when through mutualization of a concern the element of profit is eliminated. Nor does the necessity for true actuarial science vanish when the state assumes part of the premium burden. The building of rates for the purpose of effecting equity and justice between individual and individual or group and groups, the building of rates so as to stimulate the all-important work of prevention, the management of business so as to achieve the highest degree of efficiency and economy combined; these still remain a problem for the scientific insurance expert to grapple with.

No matter what our political or economic views, so long as we recognize the true social service character of our profession, we can still go on working hand in hand.

SHOULD THE COMPENSATION PREMIUM REFLECT THE EXPERIENCE OF THE INDIVIDUAL RISK?

BY

WINFIELD W. GREENE.

Experience rating of compensation risks as hitherto employed might be defined as the predication of the current rate for a given risk upon a consideration of the past experience of such risk. This practice has been confined almost entirely to cases where the insurance carrier intended to show that the rated risk had for some time past an accident experience better than the average (where an average experience means an experience productive of a cost corresponding to the basic pure premium). It is not surprising that virtually no risks have suffered an increase in rate through experience rating, since up to this time it has been customary that the request for such rating proceed from the insurer. Moreover many employers whose experience would entitle them to a decrease in rate, have not availed themselves of this advantage because of their unfamiliarity with the possibilities of the experience rating plan.

Although experience rating has been from time to time commented upon in these pages, it may not be untimely, in view of the attention now being accorded this plan in several states, to present the following summary of the principal

OBJECTIONS TO EXPERIENCE RATING.*

1. In case of small risks past experience even for a considerable period, and even if physical conditions remain stationary, is no true measure of hazard since the payroll exposure is too limited to yield a reliable pure premium.

2. Although a few large risks exhibit a payroll exposure sufficient to make even a brief experience quite significant, changes in mechanical process and in types of machinery used take place so frequently as to greatly invalidate past experience as an index of current hazard.

* The material embodied in this summary of objections to experience rating is in part due to a memorandum entitled "Experience Rating," issued by Mr. Walter S. Bucklin.

3. Safety measures, safety organization and physical conditions are believed by many to constitute a better guide to "moral hazard" than does past experience.

4. Experience rating as we have known it places the carrying company in a position to "hold the business" against all competition; this because the carrier has in its office the only records upon which an experience rating can be based.

5. Experience rating has resulted in a material reduction in the aggregate premiums collected from the risks to which the plan has been applied. Mr. Senior's helpful paper in the *Proceedings* (Vol. I, page 237), showed that in New York during the first year of the present compensation law 230 experience rated risks exhibited a net premium decrease of nearly \$78,000 which was over 24 per cent. of the premiums upon such risks as estimated at manual rates. As Mr. Senior pointed out, such tremendous shrinkage in premiums was not contemplated when the minimum adequate rates were computed. Moreover, it would appear to be inequitable that where better than average risks are written below manual, worse than average risks are not written above.

6. The business of insurance is based upon the principle that the assured shall pay a premium commensurate with the à priori probability of loss. Experience rating is an outright departure from this principle, since it permits the premium to be influenced by the individual experience of the assured.

7. By placing the actual rate-making power in the hands of the insurance carrier, experience rating weakens the ability of state officials to enforce adequate compensation rates.

8. In some instances the employer in his anxiety to exhibit a favorable experience has brought pressure to bear upon the employee to prevent his claiming compensation. (See the report of the American Association for Labor Legislation entitled "Three Years under the New Jersey Workmen's Compensation Law.")

The Industrial Commission of Colorado was moved by the foregoing considerations to rescind its approval of the experience rating plan on October 14, 1915. From a memorandum of the New York State Insurance Department dated February 17, 1916, it appears that the New York Department does not favor experience rating as practiced hitherto. However, in the same memorandum (from which we hereinafter quote), it is suggested that in compensation underwriting, it might be possible to employ

THE PRINCIPLE OF DEDUCTIBLE AVERAGE.

Since "the Workmen's Compensation Law of New York requires the employer to insure his entire compensation obligation . . . it is perhaps not feasible at this time to issue deductible average policies." Instead the Department's memorandum outlines a plan under which "every employer would pay a fixed rate for losses in excess of some fixed amount (say \$50 or \$100 each). In addition he would pay \$50 or \$100 as agreed upon, for each loss sustained during the policy term."

"This method of rating can be made applicable to much smaller risks than any method which seeks to penalize the employer for serious accidents or to reward him for their absence. The retroactive application of the plan is logical as well as defensible. It serves to adjust the premium upon the basis of conditions which have obtained during the period for which the premium was paid, instead of applying past experience as the measure of cost for a period of unknown experience which in all probability will not be identical with the past. Finally, such a system holds out to the employer an incentive for the prevention of accidents in terms of real money which he cannot fail to understand. The point we wish to emphasize is that our present plan begins at the wrong end and if properly applied would have the effect of throwing the burden of heavy losses upon the employer."

Successful application to small risks, justice to the assured and an added incentive toward accident prevention appear to be the Department's claims for the proposed plan. The first paragraph of the memorandum contains these words: "We believe it is possible to develop an experience rating plan which may be superior to schedule rating." The natural implication is that the suggested plan, which for brevity we shall term the "deductible average" scheme, is considered something of an improvement upon the schedule-rating plan.

It was suggested in the Department's memorandum that every employer pay \$50 or \$100 as agreed upon "for each loss sustained during the policy term." I am in some doubt as to whether it is meant that the employer should pay an additional sum for each compensated accident or for each accident resulting in payment of compensation or medical cost. It is essential that the basis for premium adjustment be such as not to encourage disputes and liti-

gation between the carrier and the assured. In New York and many other compensation states every compensated accident is a matter of public record. On the other hand, accidents resulting in medical cost only are not always brought to the attention of the industrial commission. Offhand, it would appear quite impracticable to collect an additional premium for every accident resulting in either compensation or medical cost.

IS THE DEDUCTIBLE AVERAGE PLAN FEASIBLE?

Let us consider therefore the practicability of an arrangement whereby the assured pays, in addition to a fixed percentage of his earned payroll, \$100 for each accident occurring within the policy term resulting in death or weekly compensation.

From the very timely paper* by Mr. Joseph H. Woodward at the last meeting of this Society, we learn that (exclusive of medical aid) the incurred loss per compensated accident was \$263.45 in the experience of the New York State Insurance Fund for the year ending June 30, 1915. From the same paper, it appears that medical cost represents 16.6 per cent. of the total compensation cost. Total incurred loss per compensated accident (including medical cost) would be therefore $\$263.45 \div .834$ or \$316. On the same basis, assuming 35 per cent. to be an appropriate expense loading for New York compensation premiums (in accordance with the recommendations of the recent conference on rates), we conclude that to pay current losses, set aside sufficient reserves and meet expenses, $\$316 \div .65$ or \$486 must be collected for each accident compensated in accordance with the provisions of the New York law.

Although it is the general impression that the risks underwritten by the New York State Insurance Fund are, on the whole, somewhat more hazardous than the average, this belief should not be given undue weight.† Assuming then for purposes of argument that ap-

* *Proceedings*, Vol. II, p. 196.

† In fact, in computing a reduction in present rates because of the deductible average feature, it would appear essential that the experience of the carrier showing the highest incurred loss per compensated accident be taken as a guide; at least this would be so as among all carriers employing the same schedule of rates. As the New York State Insurance Fund is not using the same manual of rates as the private carriers, from the standpoint of the companies it would be better if we could base our analysis upon the experience of one of their own number. Since the fund is one of the largest New York carriers and since its incurred losses have been computed

proximately \$500 per compensated accident would yield adequate premiums for New York, we are forced to the conclusion that an additional premium of \$100 per compensated accident would not justify a greater reduction than 20 per cent. in present New York rates, if present rates are adequate, but not redundant.

There is a very good reason why the plan we are discussing if adopted at all should be made to apply to all compensation risks or to all risks exhibiting annual payrolls or annual premiums within certain specified limitations. It is clear that the experience of certain risks will exhibit a higher cost per compensated accident than the average cost per compensated accident for the classification. Now, it seems likely that in the long run such risks, to whom the deductible average plan would be an advantage, would elect the plan in greater proportion than would employers whose experience shows a relatively low cost per compensated accident. In other words, the deductible average plan, if optional, would open the way to self-selection of risks to the great financial disadvantage of the carrier, since the reduction in rate, on account of the additional premium collected, would at present at least have to be predicated upon the experience of all employers.

Assuming the selection of the plan is not within the option of the employer, the following appear to be objections thereto:

1. Any innovation in compensation underwriting should be attractive to the assured unless it be of real advantage to the carrier or essential from the standpoint of public policy.* I doubt whether many employers would elect to be assessed \$100 for each compensated accident in return for a reduction of 20 per cent. in present premiums. Very many employers would, in my opinion, actively oppose the adoption of such a scheme.

upon a scientific basis, its experience may well be considered of great general value. As to the outline of the fund's method of computing incurred losses, see Mr. Woodward's paper in the *Proceedings*, Vol. I, p. 112.

* The above discussion has the New York schedule of benefits as its basis. Since this schedule is perhaps the most expensive of any American scale of benefits, it should be noted in all fairness that in certain other compensation states an additional premium of \$100 per compensated accident might justify a reduction of as much as 35 per cent. in present premiums, arguing as in the above from the first year's experience of the New York State Insurance Fund with regard to incurred loss per compensated accident. An additional premium of \$50 per compensated accident would not appear to justify a reduction in compensation premiums sufficient to be worth considering.

2. Far from being a boon to the small risk, the plan would apparently work grave hardship to many employers of comparatively small means. Several additional premiums of \$100 would well nigh drive many small establishments to the wall. The insurance carrier would probably find itself in a by-no-means enviable position with respect to the collection of these same additional premiums.

3. Many enterprises are conducted upon so narrow a margin as to make it a matter of prime importance that the current expenses be determined with reasonable accuracy at the beginning of the financial year. This situation is by no means confined to small establishments. The proposed plan would make the compensation premium an uncertain quantity not determinable in advance.

4. It was suggested in the Department's memorandum hitherto quoted that the proposed plan would create an added incentive toward accident prevention and this claim seems to be not without foundation. On the other hand, even this great justification for the scheme is outweighed if its adoption sets in motion a tendency to discourage the employee from availing himself of his rights under the compensation law. Where it means an outright loss of \$100 to the employer to have his workman remain away from duty one day over the waiting period, it is, I fear, too much to expect that some employers will not bring undue pressure upon the employee to the end that he return to work at an early date or conceal from the insurance carrier and the industrial commission the true date of return. The extent to which abuses of the nature suggested might develop under the deductible average plan is now of course a matter of conjecture. However, it would appear to be contrary to public policy to inaugurate a scheme which would create a strong economic incentive toward practices inconsistent with the spirit of the workmen's compensation law.

Apparently a plan involving the true deductible average principle whereunder the employer would bear the actual loss up to a certain maximum would be open to all of the foregoing objections in greater or less degree; and the original experience plan exhibits many disadvantages from the standpoint of the underwriter as well as being somewhat incompatible with the spirit of the compensation acts. Is there any form of experience rating more defensible than the types we have discussed?

A type of rating system has been suggested which might be briefly defined as

RETROACTIVE EXPERIENCE RATING OF ALL LARGE RISKS.

It is proposed that *all* risks whereunder the earned yearly premium at manual or schedule rates is in excess of a certain amount, say \$5,000, be experience rated and that the reduction or increase in rate be made at the end of the insurance period upon the basis of a scientific evaluation of the experience during that period. It may at once be stated that this modified plan is infinitely less objectionable than experience rating as we have known it, principally because reductions in rate for good experience will be balanced by increases in rate on account of unfavorable experience. I feel, however, that it would be unwise to adopt even this modified plan for the following reasons:

1. The carrying company or fund will still have an undue competitive advantage. This advantage would arise from its possession of the experience record of the assured. Skilled supervision on the part of a central rating board might do much to prevent actual manipulation of the experience record; the possibility of such manipulation would, however, still loom large in the eyes of the assured.

2. The very fairness of the modified plan would make it most unpopular. The experience of most employers affected by the new plan will undoubtedly exhibit a material fluctuation in compensation cost from one insurance period to another (see paper of Albert H. Mowbray, *Proceedings*, Vol. I, p. 24). One year the assured will receive a most gratifying dividend—the next year the shoe will be on the other foot, and the dividend will be a negative quantity, resulting in a most unsatisfactory item of disbursements not contemplated at the beginning of the fiscal period.

As far as the employer is concerned the real demand for experience rating up to this time has arisen from a desire to get insurance at better than average cost. It is true that the new plan will permit the employer with a consistently favorable experience to still realize his ambitions in this regard. The employer whose experience is unfavorable will, on the other hand, find the cost of his insurance increased; and in my opinion, he will complain to such good effect that carriers and supervising authorities alike will be most happy to discontinue the experience plan altogether.

3. It seems to me that any form of experience rating whatever holds up to the employer an economic reward for the prevention of

compensation claims. *The unscrupulous employer may achieve this reward not so much by accident prevention as by discouraging the employee from availing himself of his rights under the compensation law.*

Now in compensation insurance the terms "loss prevention" and "accident prevention" are not synonymous,—and before drawing our final conclusions it may be well to elaborate this point.

In fire insurance, it is clearly consistent with public policy to work directly toward the prevention of financial loss.

From the standpoint of the community it is immaterial whether this loss prevention takes the form of restriction of combustion or prevention of ignition. Since combustion imposes a direct loss upon the assured under a fire insurance policy, we need fear no tendency upon his part to minimize the amount of loss in dollars and cents.

In compensation insurance the occurrence of the accident corresponds roughly to the fact of ignition, while the seriousness of the injury corresponds to the extent of combustion. At this point the analogy stops, for the compensation loss is sustained in the first instance not by the assured himself, but by a third person, viz., an employee. Where the employer carries his own risk, or where under a compensation policy he knows that a favorable experience means a low rate, we cannot in all cases trust him to reveal the full extent of loss (where loss means the amount of compensation corresponding to the seriousness of the injury).

CONCLUSIONS.

It has been the intention of the writer to indicate in the foregoing pages that in all probability any system of compensation rates dependent upon the experience of the individual risk will be if universally applied so unpopular as to be virtually unworkable; that the chief genesis of the demand for consideration of individual experience in rating compensation risks lies in the hope for competitive advantage on the part of the carrier; and finally that although experience rating plans have sincere advocates among those who feel that such plans may constitute powerful influences toward accident prevention, there is reason to fear that experience rating in any form may harm rather than help the employee through giving the employer a financial interest in minimizing his workmen's claims.

If I mistake not, Dr. I. M. Rubinow in his illuminating work "Social Insurance" sets forth that in European countries the practice of permitting employers to carry their own risk has been found to work serious disadvantages to the employee. Workmen entitled thereto have failed to claim compensation through fear of dismissal, while employees with families or those whose age or physical condition makes them susceptible to injury have found it extremely difficult to obtain employment. If self-insurance tends to develop these abuses, experience rating would also be productive of them and in larger measure; for while permission to pay compensation directly is presumably granted only to the employer of financial responsibility, experience rating applies to many employers who are in no position financially to be more liberal with their employees than the exigencies of their situation may require.

We shall be making sufficient progress if for the present we devote our energies toward the development of methods whereby more equitable basic rates may be computed, and toward improving schedule rating systems and broadening the field of their application. Self-insurance should be conditioned not merely upon financial ability, but upon the spirit exhibited by the employer toward the grave obligations imposed upon him by the compensation law. Carriers issuing participating contracts should be required to calculate their dividends with respect to their entire experience or with respect to the experience of large groups, each group including many risks. The employer should not be encouraged in the false idea that his own experience is a proper criterion for an equitable rate.

THE EXPERIENCE RATING OF WORKMEN'S COMPENSATION RISKS.

BY

JOSEPH H. WOODWARD.

DEFINITIONS.

A workmen's compensation risk the premium for which is based in part upon the loss ratio developed for the individual risk is said to be *experience rated*. An experience rate is differentiated from a *schedule rate* by the fact that, as commonly used, the latter term is confined to a rate based upon a detailed inspection of the physical condition and hazard of the plant of the employer, and of his methods of operation. A *merit rate* may be either a schedule rate or an experience rate, or it may be a rate based partly upon inspection and partly upon experience. Experience rating is distinguished from profit sharing or mutual insurance by the fact that it has regard to experience under individual policies as distinguished from experience in groups or classes of policies or for the company as a whole.

WHY EXPERIENCE RATING IS DESIRED.

Several conditions have given rise to a demand for some system of experience rating.

1. An employer who, through good fortune or good management, has fewer or less costly accidents than other employers in the same business or industry, regards his rate, justly or unjustly, as excessive, and insistently demands relief.

2. Under conditions of unregulated competition between insurance companies experience rating has in the past offered a convenient and specious means of granting discriminatory favors to particular policyholders and of conciliating agents and brokers controlling compensation and other collateral lines of insurance.

3. It may well be argued that by properly rewarding an employer for good experience and penalizing him for bad experience we have a cheap and easy means of encouraging organization for

safety and the guarding of machinery, thus conserving human life and limb.

EXISTING SYSTEMS.

Before passing to considerations of theory it will be helpful to refer briefly to four different systems that are in actual operation in the United States at the present time. These are:

- I. The Massachusetts System.
- II. The New York System.
- III. The Ohio System.
- IV. The Service Bureau System.

THE MASSACHUSETTS SYSTEM.

Under the Massachusetts "Plan of Experience Rating, 1916," promulgated by the Massachusetts Rating and Inspection Bureau and approved by the Insurance Commissioner, every risk which can supply the requisite payroll exposure is compulsorily subject to experience rating. The rate modification is based upon the experience for the entire period during which the risk has been insured for workmen's compensation, but not more than five years, "nor less than twelve months preceding a date six months prior to expiration of the risk." The amount of payroll during the period covered by the experience must be at least \$25,000. A credit of $\frac{2}{3}$ of 1 per cent. of the manual rate is allowed for each decrease in loss ratio of 1 per cent. below 45 per cent., the maximum credit being 30 per cent. of the manual rate. A debit is imposed of 1 per cent. of the manual rate for each increase in loss ratio of 1 per cent. above 65 per cent., the maximum being 30 per cent. The region between 45 per cent. and 65 per cent. is called the "neutral zone." In the case of risks also subject to schedule rating the application of the rule is modified so that the maximum credit for merit rating will not exceed 40 per cent. The loss ratio is determined by classifying accidents under the following heads:

1. Fatal.
2. Causing total permanent disability.
3. Causing dismemberment (further subdivided).
4. "Tabulatable" accidents (causing loss of time on any day other than the day of injury).

An assumed average number of weeks' compensation is stipulated to be applied in each of the above classes and this factor is multiplied by the weekly compensation actually awarded. Medical cost is taken at \$11 per tabulatable accident. By summing the items thus obtained a hypothetical loss cost is derived from which the "loss ratio" of the risk is determined.

THE NEW YORK SYSTEM.

Under the New York "Rules for Experience Rating," promulgated by the New York Compensation Inspection Rating Board under date of January, 1915, and approved by the Superintendent of Insurance, risks may be experience rated upon application by a member company. The submission of such application is optional with the carrying company and this feature of the plan has led to such abuses that, following a suggestion from the Superintendent of Insurance, a special committee of the Board has been appointed to revise the system. To secure a rating, experience covering a period of not less than two years nor more than five years must be submitted, thus permitting to a certain extent the submission of employers' liability as well as workmen's compensation experience. The total payroll for the period of the experience must be not less than \$25,000. Debits or credits are created according as the loss ratio developed is greater or less than 50 per cent. On risks where the payroll submitted is \$100,000 or over, the maximum debit and credit is 30 per cent. for risks not subject to schedule rating, and 20 per cent. for risks which are subject to schedule rating. Credits and debits are somewhat less for smaller payrolls. The general method of evaluating the experience does not differ materially from that employed in the Massachusetts system.

THE OHIO SYSTEM.

The present Ohio system is fully described by Mr. Emile E. Watson, actuary of the Industrial Commission of Ohio, in a paper read before the National Association of Industrial Accident Boards and Commissions on April 26, 1916. Save as applied to contracting risks, the Ohio system is one of debits only, the premium rates of the Ohio fund being "preferred" rates. The maximum debit is 24 per cent. of the preferred rate. The method of applying the experience is based partly upon the number of compensatable acci-

dents, partly on their cost, partly on their gravity, and partly on the base rate for the classification. In the case of contracting risks, for reasons stated by Mr. Watson, a system of credits only has been devised. The Ohio credit system appears to be a notable improvement over the Ohio debit system. The Ohio system appears in general to be unnecessarily complex and difficult to understand, although it doubtless achieves in many cases the results intended of it. It would not be practicable for use in states where compensation insurance is written competitively.

THE SERVICE BUREAU SYSTEM.

A fourth system of experience rating in actual use is that employed by member companies of the Workmen's Compensation Service Bureau in states where no special system is provided and where experience rating is permitted by the supervising authorities. So far as the actuarial and statistical principles involved are concerned, this system does not differ greatly from the Massachusetts and New York systems.

THE INFLUENCE OF THE SIZE OF THE RISK ON THE RULE FOR RATING.

Aside from arguments against experience rating based upon the opportunities which it may offer for abuse when used in competition and upon the expense and administrative difficulties which in practice are involved, the chief theoretical objection urged by its opponents is that it tends to violate the fundamental principles of insurance by running counter to the laws of average. This objection deserves the closest scrutiny and I venture to believe that a full analysis thereof will disclose the entire underlying theory of the subject.

If we consider any workmen's compensation risk individually and apart from other risks we shall expect that at the end of any policy year the losses will not exactly balance the pure premium. It may fairly be said that under a given policy the actual loss will always be greater or less than the pure premium or expected loss, since those cases where the actual and expected losses are exactly equal are coincidences so rare as to be negligible.

The difference between the expected loss and the actual loss for a particular risk during a particular policy period I shall refer to

as the *deviation* of the experience. This deviation may be regarded as made up of two component parts, which it will be shown call for two radically different methods of treatment in any sound experience rating plan. These two parts are:

A. The error in the pure premium, considered as an average premium, which arises from the fact that it does not exactly measure the true expectation of loss. This error measures the departure of the hazard of the risk from the hazard of average risks within the classification. I shall call that part of the deviation arising from this error the *hazard deviation*.

B. That deviation of the actual loss from the expected loss which is the result of chance, assuming that the pure premium exactly reflects the true expectation of loss. This deviation I shall call the *chance deviation*.

Consider the properties of these two kinds of deviation. The hazard deviation might doubtless be attributed to a considerable number of mutually independent causes. For the purposes of the argument, however, it is unnecessary to analyze it further except to say that, in a general way, it reflects the fact that rate makers are human; that the statistics underlying our basic pure premiums are inadequate and defective; that industrial conditions are in a constant state of flux; that schedule-rating systems based upon physical or objective features of the risk are of necessity to a large extent arbitrary. While it is certainly possible as time goes on to continuously reduce the hazard deviation, it can never be wholly eliminated. Efforts to correct it, however, by means of experience rating should not be permitted to supplant efforts to secure constantly better classification of risks and constantly increasing accuracy in the pure premium and in schedule rating. The attractive and laudable idea of the use of experience rating to encourage safety measures and organization contemplates a modification of the hazard deviation. By offering hope of reward the employer is to be induced to make changes in the plant which reduce the expectation of loss.

But the most useful fact to be observed in connection with the hazard deviation is that it grows increasingly important, relatively to the chance deviation, as the size of the risk measured by the payroll exposed, or preferably, by the expected loss, increases. Thus, on a very large risk, the experience on that risk alone as distinguished from the general experience in the classification to which

it belongs is really of greater weight in determining the price at which it may equitably be underwritten than the manual premium itself. If a single risk were large enough to practically comprise a large industry in itself, it could be rated entirely upon its own experience, without reference to the experience on any other risk. I do not attempt in this connection to define in dollars and cents exactly the limit at which a risk may be regarded as "very large." It must, however, be large enough to cause the probable deviation due to chance to be fairly small.

Under the head of chance deviation, must be considered those departures of the actual loss from the expected loss under a particular risk which arise from the operation of the laws of probability, excluding absolutely deviations arising from the fact that the pure premium does not accurately represent the true expectation of loss. (By *true expectation of loss* is meant the product of the manual pure premium rate multiplied by the payroll, on the assumption that, as an average rate, it exactly reflects the *a priori* hazard of the risk.) With respect to these chance deviations, we first observe that they may be either positive or negative—that is to say, the actual loss may be greater or less than the expected loss. Positive deviations may be infinitely great—that is, under an ordinary workmen's compensation policy there is no limit in law or in theory to the size of the loss which may arise. On the other hand, negative deviations are strictly limited to the amount of the expected loss itself. In other words, we can never save more than the office premium less the expenses. These considerations explain why it is so difficult to construct an experience rating system under which the debits will equal the credits, a difficulty which is entirely apart from the practical problem of providing debits which will materialize in actual operation.

By far the most important property, however, of these deviations arising from chance is the fact that the percentage of deviation to premium (not the absolute amount of the deviation) varies inversely as the expected loss—that is to say, it becomes smaller and smaller as the pure premium exposed to risk increases. It is clear then, that in dealing with this element of the problem we have to do with a subject which may properly and advantageously be subjected to exact mathematical analysis.

It is because of this fact that when the expected loss is small the probable chance deviation is great that an experience rating system

purporting to be a measure of physical or moral hazard—that is, of the hazard deviation, is inapplicable to small and average-sized risks. In other words, for a small risk—and I do not undertake here to define exactly within what limits a risk is to be considered small—deviations due to chance so far outweigh deviations due to difference in physical or moral hazard that these quantities become almost incommensurable in magnitude. The only “experience rating” properly applicable to chance deviations must amount to nothing more or less than a system of partial self-insurance or its equivalent.

It is most unfortunate that statistics analyzing the loss ratios under workmen’s compensation policies arranged according to the size of the policy are almost wholly lacking. Through the courtesy of Dr. E. H. Downey, however, I am able to present the following table based upon data compiled by the Industrial Commission of Wisconsin under date of August, 1915, and covering the experience in Wisconsin on 2,195 individual policies:

WISCONSIN EXPERIENCE—2195 POLICIES.

Loss Ratio, %.	Number of Policies.	Premiums.	Average Premium.	Losses.	Average Loss Ratio, %.
0..	1,738	\$ 65,312	\$ 37.58	\$ 0	0
1-10..	124	38,772	312.68	1,893	4.9
11-40..	138	58,864	426.55	17,320	29.4
41-100..	82	46,444	566.39	31,158	67.1
Over 100..	113	19,883	175.96	57,277	288.1
Total.....	2,195	\$229,275	\$104.45	\$107,648	47.0

It will be noted that over 75 per cent. of the policies experienced no losses whatever and that over 50 per cent. of the losses arose from about 5 per cent. of the policies.

An analysis at one time made of the business of the New York State Insurance Fund showed that out of 6,373 policies in force at the time of the investigation, 5,436 were for semi-annual premiums of from \$5 to \$50; 455 from \$50 to \$100; 346 from \$100 to \$500; 68 from \$500 to \$1,000; and 68 over \$1,000. The average premium for six months for the 68 policies carrying a premium of \$1,000 and over was \$6,124. Out of 250 policies selected at random with semi-annual premiums under \$100 and greater than the minimum premium, there were only 24, or a little less than ten per cent. of the total, under which any losses whatever had been paid or reported for the six months period under review. Of these losses,

17 were for less than \$50
5 were between \$50 and \$100
2 were \$100 or over
<hr/> 24 total

These figures furnish, perhaps, extreme illustrations, but they serve all the more clearly to show that among small risks chance plays an overwhelmingly dominant role in determining the experience under individual policies. In dealing with small policies it is interesting to note that the only experience rating system which would produce sufficient charges to offset the credits must be a system of partial self insurance or its equivalent.

PARTIAL SELF INSURANCE.

A plan tentatively brought forward in a memorandum of the Superintendent of Insurance of the State of New York dated February 17, 1916, provides just such a system. It contemplates a contract written at a reduced rate of premium and providing for extra charges for experience to be based in some manner upon either the number of accidents or the cost of accidents arising during the policy term. An objection to this method is that it uses debits only, and that the collection of debits has in the past carried with it certain difficulties of an administrative nature which are believed to make them undesirable. The practical objection to debits, however, has arisen in large measure from several conditions which would not apply to the debits provided by the plan described. The first difficulty has been the indisposition of the company or broker to apply debits where they increased the premium, for fear of dissatisfaction on the part of the assured. But where in the past the policyholder has objected to premium increases, it must be remembered that these increases were based upon a more or less mysterious system of schedule rating which was not definitely described in the contract. Under the plan referred to any dissatisfaction would be largely, if not wholly, eliminated, for the reason that the policy provision would be so clear that any employer could figure out his experience rate himself, and that furthermore, he might properly and without involving any discrimination, be given the opportunity to elect whether the policy should be written under this plan at all.

There are two forms which it appears that such a plan might take. The policy might provide that at its termination the pre-

mium shall be subject to increase by an amount equal to, say, \$100 for each accident arising during the policy term which has cost at least \$100; or if the accident has cost less, that then the premium shall be increased by the actual cost of the accident. This scheme involves certain practical difficulties and delays in determining the actual cost of the claims arising during the policy period which might prove an impediment to its smooth operation. These difficulties, however, could be avoided by providing that for every compensatable accident arising during the policy term—a compensatable accident being defined as one resulting in an award of compensation under the act—there shall be added to the premium a certain fixed sum. The amount of this addition could easily be determined promptly at the close of the policy year, since it is merely necessary to know whether or not the accidents arising are compensatable, and this is about the simplest information that could be demanded with respect to any experience. It would be possible to very accurately estimate the reduction in advance premium which could be granted under a provision of this kind, although it is likely that certain modifications of the percentage might be advisable in the case of a few special classifications. The chief practical objection to such a plan is that the advance reduction in rate which could properly be offered would be so small as in all probability to prove unattractive. There is a general lack of appreciation of how comparatively large a proportion of the premium is required to pay for the comparatively rare serious losses.

APPLICATION TO LARGE POLICIES.

It is with greater profit that we may consider the applicability of experience rating to large policies. These large policies comprise the risks on which there is the most pressing demand for experience rating, the payrolls and premiums exposed being sufficiently large to make the experience have some reasonable meaning. But these cases represent only a small percentage of the total number of policies in force. It may not be unreasonable to assume that in the average company there are not over, say, five per cent. of the workmen's compensation risks for which there is a legitimate demand for a modification of the rate based upon the experience of the risk. When we consider that under such a law as that of New York an accident to a single employee may cost as much as \$10,000, it becomes apparent that any system of experience rating which

purports to be universally applicable to risks of all sizes, or even to the majority of risks, must contemplate a vast amount of expensive and meaningless office work.

The principal theory upon which experience rating has been defended is that it serves to reflect the moral hazard of the risk. This theory is very fully developed in an article by Mr. D. S. Beyer in the *Economic World* of April 15, 1916. Under the Massachusetts and other plans in actual use, it is apparent that the dominant idea is that of measuring the moral hazard as distinguished from providing partial self insurance. Such a plan necessarily fails to live up to its pretensions when applied to small risks, since, as is well said by Mr. Beyer in the article referred to:

“ . . . the good or bad experience of a plant *may be due merely to its size*, and the logical working out of the general law of averages. For example, the average-sized Massachusetts plant of eighty employees should not have more than one fatal accident in fifteen years, if it conforms with the general average of the industries of the State. The plant with ten employees should not have more than one fatality in 120 years; it should not have an accident involving two weeks' lost time more than once in three years, and in low hazard industries once in ten years.”

When, therefore, we attempt to apply experience rating to small plants it is obvious that what we are doing is not so much reflecting the moral hazard as tampering with the law of averages. For a very large risk, on the contrary, assuming the basic rate to be correct, the deviation of the actual loss is determined almost wholly by the moral hazard and scarcely at all by the influence of chance.

FUNDAMENTAL TESTS.

The fundamental problem of devising an experience rating plan which will be of general application is to so harmonize the idea of partial self insurance and the idea of experience as an index of the physical and moral hazard as to cause the plan to produce consistent and equitable results within the limits laid down for its application. The test for any plan intended for general application should be made by applying it to a large number of concrete cases in the following classes:

- (a) Small risks.
- (b) Medium-sized risks.
- (c) Large risks.

No plan may be considered to pass the test unless, as respects small risks taken as a class, it produces debits at least equal to the credits, and that, as respects the medium-sized risks taken as a class it produces debits nearly equal to the credits. In respect of the large risks, I believe it will be found that any equitable experience-rating plan will result in somewhat greater credits than debits, for the reason that large risks are, as a matter of fact, better than small risks in the same classification. This, then, would mean that as respects the large risks it is not necessary, and indeed, probably undesirable, that the debits produced should exactly balance the credits. The ends to be sought can in my judgment be best obtained by (1) exempting altogether the smaller risks—say those where the annual premium is less than the average value of one fatal accident—from the operation of the plan; (2) providing a “neutral zone” which will vary with the size of the risk and (3) providing a scale of maximum debits and credits which decrease as the size of the risk decreases. Special care should be taken that credits are not made too large.

ACTUAL EXPERIENCE VS. AVERAGE ACCIDENT VALUES.

Most plans in actual use provide for the basing of the modification in rate upon a loss ratio derived from average claim values as distinguished from actual experience. This is said to reduce the operation of chance in the experience. If all compensatable accidents were given equal weight this might be true, but it is difficult to follow the force of this argument so long as death claims, total permanent disabilities, etc., are separately rated. Any system of average loss ratios would probably be satisfactory to the employer so long as it produced a figure which was less than the actual loss ratio. Where, however, the hypothetical or fictitious loss ratio produced by the use of averages exceeds the actual loss ratio under the risk, dissatisfaction with the rate sooner or later ensues. The objection has been raised to the use of actual experience that it is not possible to ascertain the facts sufficiently soon. It is my experience that ninety 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. The fluctuations in experience due to the chance incidence of large claims may be sufficiently controlled by other

features of the rating plan. The use of actual experience avoids the absurdities which invariably result in particular cases from a system of weighted averages and consequently makes a more practical appeal to the employer. Under an average value system, it is possible for a debit to be assessed against an employer which is obviously not required by the actual experience under the policy. Especially if "tabulatable" accidents are used in preference to "compensatable" accidents an average value system gives wide scope for manipulation and ambiguous interpretation. An experience-rating plan to inspire confidence, should be based upon actual and not upon fictitious or hypothetical experience.

PAYROLL *vs.* PREMIUM AS A MEASURE OF SIZE.

The size of a risk is ordinarily measured by the amount of the payroll exposed. But for purposes of considering the departure of actual experience from expected, the size of the hazard is indicated by the expectation of loss—in other words, the pure premium. The governing consideration, from the standpoint of probabilities, is the proportionate effect which one or more serious losses would have upon the experience under the risk. Thus, \$100,000 payroll at a rate of \$1 gives a premium of \$1,000; \$100,000 at a rate of \$10 gives a premium of \$10,000. A death loss costing \$5,000 increases the loss ratio in the case of the first risk 500 per cent., while it increases the loss ratio in the case of the second risk by only 50 per cent. Consequently, it is clear that although these two risks carry the same payroll they should not be treated according to the same rule for experience rating purposes, since the first risk is exposed to a much more fluctuating loss ratio than the second risk. Furthermore, if the premium is taken as the measure of size, we avoid all question of the treatment of subordinate classifications, such as clerical office force, drivers, etc. In a manufacturing or contracting risk, for example, the clerical office payroll is relatively of slight importance in measuring the size of the risk for insurance purposes. By using the premium as the measure instead of the payroll, the clerical office employees are automatically given their true weight.

PROSPECTIVE AND RETROSPECTIVE RATING.

In actual practice, the experience upon a risk, where it has been allowed to affect the rate at all, has usually been applied to modify

the premium for a policy period succeeding that in which the experience was developed. This manner of applying experience has been described as *prospective*. Where, on the contrary, experience is applied to modify the rate for the period during which the experience was developed, the risk is said to be rated in a *retrospective* manner. Under the retrospective plan, the modification in rate is always effective for the insurance carrier under whose policy the experience occurs. Under the prospective plan it happens that when a risk changes hands, the carrier securing the renewal may be required to apply a rate based upon the experience of the risk with some other carrier. Furthermore, the actual result to the policy holder is quite different under the two systems, since under the prospective system the *percentage* of credit or debit derived from *past* experience is applied to a *future* premium. Since the payroll of the employer may fluctuate materially from period to period, especially in the case of contracting risks, it is obviously impossible to obtain results under a prospective system which are free from discrimination. To the extent that experience rating measures the moral hazard of a risk, there is some justification for the prospective manner of application, even when it goes so far, as in Massachusetts, as to use parts of the experience over and over again for a number of years. To the extent, however, that such rating is of the nature of self insurance there would seem to be no such justification. The practical appeal of the prospective system arises from the fact that it frequently enables a concession in the advance rates of premium to be made at the time of soliciting the business. This consideration has apparently outweighed the scientific arguments for a retrospective system in determining the plans which have been actually adopted for use. A practical advantage of the prospective system is that it makes it easier to collect any debits which may arise from bad experience. In choosing between a prospective and retrospective plan, the language of the policy contract should be given careful consideration, and if a retrospective plan is to be adopted, it should be made certain that the debits will be legally collectible. Since the premium has to be adjusted at the end of the policy term for payroll audit, the retrospective system has the advantage of bringing the adjustment for experience generally coincident in time with the adjustment for payroll audit. 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. This temptation is largely removed under the other plan.

COMPETITIVE ABUSES.

No student of compensation rate-making should fail to read a brief on the subject of experience rating prepared by Mr. Theodore E. Gaty, and submitted to the Superintendent of Insurance of New York, on February 17, 1916. This brief was reprinted in the *New York Journal of Commerce* of February 21, 1916. Mr. Gaty demonstrates very clearly that the history of experience rating is in large measure a history of competitive abuses. It is shown that the early liability rates which purported to be based upon individual experience and which were known as "special rates" arose not from any desire to secure superior equity as between employers, but simply as a means of defense against competitive inroads upon premium income. Under such conditions it was quite natural that scientific considerations had very little to do with determining the rate, that discrimination between policyholders was frequent, and that many of the insurance companies, particularly the smaller ones, were forced to call on their stockholders for large contributions to surplus. With such a history, it naturally follows that special pains should be taken that any experience rating system of the present day should be safeguarded in every possible way against competitive abuses.

CONCLUSION.

It is difficult at this time to present an impartial general survey of a subject so controversial. In this paper, however, I have endeavored to give the arguments on both sides of the principal questions concerning which there exists marked diversity of opinion. It is hoped that the paper is one which can be profitably used by students endeavoring to get a comprehensive view of the general subject. I shall feel quite content if I have succeeded in indicating how much is yet to be done to properly develop a scientific theory of experience rating, and how great is the necessity for adequate statistics relating to this subject.

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

BY

GEORGE B. BUCK.

The City of New York is facing the problem of reorganizing its pension systems. Its methods of meeting this problem may be of general interest in that the inherent defects of its system, which have forced a reorganization, are commonly found in municipal systems throughout the country.

According to the Commission's records, the first law relating to pensions for municipal employees in this country was passed in 1857. This law was passed by the New York Legislature and applied to policemen of New York City. In the next year \$30 were expended in pension payments by the city; in the first thirty years about \$1,342,000 were paid out; but last year over \$5,000,000 were disbursed. In other words, in one year the city is now disbursing over three times as much as it did in the entire first thirty years of its pension experience, which is at a rate over one hundred times as great as the average of the first thirty years. But this is not all. Pension laws did not formerly include all city employees in their scope—the pension payments are therefore small to what may be expected. Within the last five years legislation has been broadened to cover over 35,000 additional active employees. The pension load from this source has not yet made itself evident.

But what about the assets of the funds? The pension payments are enormous but they do not represent an extravagant pension policy in themselves when contrasted with the present payroll of \$99,000,000, if it were not for the fact that the payments are increasing by leaps and bounds and no adequate methods have been provided for meeting them. Each of the funds is in the position of an insolvent insurance company that has no reserve and which is constantly adding new policyholders and using their premiums to pay maturing claims. Fortunately the insurance laws will not permit this in the case of companies, but thus far pension funds are

not restricted. New York City has set aside certain excise and other indirect taxes to cover the liability but these funds are wholly inadequate to meet the future demands. So far the systems have been financed on the assessment basis, as it were, by continually adding new sources of revenue as the others become inadequate; but this method is becoming more and more onerous, so that some reorganization of the general system of financing seems imperative.

Practically all of the 228 cities in the United States with more than 25,000 inhabitants have pension systems of some kind. The eighteen cities with a population of over 300,000 pension their firemen, policemen and teachers; and seven of these cities have additional funds for other branches of the municipal service. The majority of these cities, like the City of New York, have failed to exhibit forethought in providing for the actuarial soundness of their system. The time is approaching when either faith cannot be kept with their employees or the cities themselves will be overburdened by a financial strain for which they have not made adequate preparation. The size of the New York system and the longer period of its establishment have resulted in a more imperative need for reorganization than elsewhere. The fact that New York is a pioneer in this field gives peculiar value to the results of its experience.

The Commission on Pensions of New York City was appointed by Mayor Gaynor in the summer of 1913, to inquire into the present situation of the city as regards pensions and to recommend such changes as might be considered desirable. In 1914 a staff was organized to carry on the necessary statistical and actuarial work. The first question which was asked of the staff was: "What about the existing funds, do they meet the requirement of properly relieving the superannuation problem and what will they cost, if continued?" The preparation of the answer to the second half of this question was assigned to the author, who fortunately had the advice and counsel of a distinguished committee of actuaries appointed by the Actuarial Society of America, to act as an advisory committee to the Commission in its work. This committee consisted of Mr. William A. Hutcheson, Actuary of the Mutual Life Insurance Company; Mr. Robert B. Henderson, Actuary of the Equitable Life Assurance Society, and Mr. Henry Moir, Actuary of the Home Life Insurance Company.

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 of prospective cost or pension liability could be made. The task was that of valuing the assets and liabilities of one of the largest insurance and annuity carriers in this country and there was not available even a list of policyholders, much less the proper experience tables upon which reserves or any calculations of prospective liability might be made.

The first step of the Commission was to obtain adequate data both in regard to employees covered and in regard to employees who had separated from the service, during a period of six years, which was adopted as a proper basis for the experience. There had been no centralized administration of these funds and no adequate records had been kept from which the Commission could directly obtain its data. Uniform schedules bearing necessary data were secured, therefore, for all employees actively employed on June 30, 1914, the date set for the valuation. Another schedule was obtained from each pensioner. From such sources as were available, records were collected in regard to out of service employees and pensioners who had been separated from the roll in the period of experience.

The extent of the data that was collected is indicated by the fact that over 76,000 employees on a payroll of \$99,000,000 were accounted for. The out of service cards numbered 29,000. The number of dependents considered was over 60,000. The combined exposure of active employees in the period amounted to nearly 395,000 years.

New York City covers all of its employees by means of nine distinct funds and as one of these funds covers such dissimilar classes of employees that it had to be subdivided before experience tables were prepared, twelve distinct services had to be investigated. For these twelve services, altogether some twelve active service tables were prepared and as many pensioners' mortality tables were constructed or adopted for use. A complete account of the methods of dealing with the data and the procedure followed in deriving all basic tables is given in the Actuarial Report of the Commission, which is now in the hands of the printer.

Perhaps the tables of greatest general interest to the actuary or statistician in the Actuarial Report are those giving data to be used in the valuation of benefits to widows and children. The

Commission in its study of municipal and industrial pension funds in this country was unable to locate a single source from which such data could be obtained in a form suitable for use in a valuation. Actuaries in this country have used data compiled abroad for this purpose. The work of the Commission makes available for the first time some American data based on tabulations covering about 84,000 persons in all.

Although a detailed description of such data is given in the report, it might be well to draw to your attention the special features covered. It was found that the family history data tabulated showed little correlation with the occupation of the employee. Therefore, all experience was combined to form a single basis for a single set of tables. The tables presented cover the marital condition of employees by age and the average age of wife to that of husband for each age of husband.

Full tabulations are presented of the total number of children per family, classified by age, and of all youngest children per family, classified by age. The work of the Commission required the average age of the youngest child of the father dying and the proportion of fathers leaving a youngest child under age of eighteen. These adjusted values are given, in which, moreover, a distinction is made between children of husbands and those of widowers and divorcees.

General methods of valuing pensions have been already expounded by Messrs. Manly, King, M'Laughlan and others in their admirable papers before the Institute of Actuaries and the Faculty of Actuaries. To develop the fundamental principles at this time would be a repetition of what has already been most ably done, consequently it seems advisable to bring forward certain methods of valuing which have been found of service in appraising funds which do not admit of valuation by any of the methods which have thus far found their way into the chief repositories of such information, the publication of the actuarial societies. These methods refer to the valuation of those funds to which aggregate tables are not directly applicable.

The use of select service tables has been generally recognized as an ideal method of reflecting the peculiarities of certain services. Mr. George King, in a discussion of this point before the Institute of Actuaries, has remarked that "Some day actuaries would be driven to use select tables," that he was "quite sure it made a

great deal of difference at certain ages of entry if the subject were treated by the select method." The theoretical nicety of results to be obtained by select methods has generally been overbalanced by the attendant practical difficulties, the thought of which, as Mr. King relates, was sufficient, when he predicted the use of select tables to the Institute of Actuaries, to "cause a shiver to go round the hall." Probably everyone who has had experience in pension fund valuation enjoys the aforesaid "shiver" when select tables are mentioned. But the sensation is highly intensified when such a one finds himself for the first time confronted with the valuation of a fund which will not admit of handling on an aggregate basis. In such a case the mechanical short cuts hereafter described may be of service.

It was found in certain of the services covered by the Commission's investigation, and similar conditions are frequently encountered in industrial pension funds, that the rates of resignation and dismissal, when developed on the aggregate basis, averaged in the neighborhood of from 10 per cent. to 15 per cent. for the ages 20 to 40, which made the use of an aggregate table impracticable, because, no matter what radix was assumed at age 20, the employment of such a high rate in the construction of a table reduced it almost to a decimal within a very few years, thus rendering the table unfit for valuation purposes. The reason for such an excessive rate of withdrawal was because of the wholesale resignations and dismissals which occurred among employees with less than four or five years' service. Various methods were tested for overcoming this difficulty but the results did not commend them for use. Finally the following method was devised, which is best described by a consideration of one of the actual services demanding select development.

In the New York City Street Cleaning Department the rates of resignation and dismissal were found to be comparatively high in the first three years of service, whereas the rates of death and disability did not show a material variation with years of service. The experience was prepared on a select basis for the first three years of service and the experience for the remaining years of service carried on an ultimate basis. Rates were then graduated from the select experience only for those contingencies which showed a direct variation with years of service; that is, the contingencies of resignation and dismissal. From the ultimate expe-

rience, rates of death, disability and service retirement were derived in addition to ultimate rates of resignation and dismissal.

A service table was constructed as follows: The ultimate column of the table was run according to the ordinary method of constructing an active service table. The values for the number living for the select periods of service were built up on this, not by the ordinary method of dividing the number living in the ultimate column by the probability of living for the next earlier age and year of service, but by adding the numerical value of the ultimate decrements caused by death and disability to the ultimate number living and then by dividing the result by the complement of the combined select rates of dismissal and resignation.

The method is more clearly described by the use of symbols.

Let the rates graduated be represented as follows:

${}^{dw}q_{[x]}$; ${}^{dw}q_{[x-1]+1}$; ${}^{dw}q_{[x-2]+2}$ = rates of dismissal at age x in the first, second and third years of service respectively.

${}^{rw}q_{[x]}$; ${}^{rw}q_{[x-1]+1}$; ${}^{rw}q_{[x-2]+2}$ = rates of resignation at age x in the first, second and third years of service respectively.

${}^{dw}q_x$ = ultimate rate of dismissal.

${}^{rw}q_x$ = ultimate rate of resignation.

dq_x = ultimate rate of death.

${}^{ir}q_x$ = ultimate rate of disability.

${}^{or}q_x$ = ultimate rate of retirement.

The first step—the construction of the ultimate table—is represented by

$$l_x = l_{x-1} \cdot [1 - ({}^{dw}q_{x-1} + {}^{rw}q_{x-1} + {}^dq_{x-1} + {}^{ir}q_{x-1} + {}^{or}q_{x-1})].$$

The ultimate decrements are obtained:

$$\text{Ultimate deaths} = d_x = l_x \cdot {}^dq_x,$$

$$\text{Disability cases} = {}^{ir}r_x = l_x \cdot {}^{ir}q_x,$$

$$\text{Regular retirements} = {}^{or}r_x = l_x \cdot {}^{or}q_x, \text{ etc.}$$

Then the column representing those living in the third year of service is obtained as follows:

$$l_{[x-2]+1} = \frac{l_x + d_{x-1} + {}^i r_{x-1} + {}^o r_{x-1}}{1 - ({}^{aw} q_{[x-2]+1} + {}^{rw} q_{[x-2]+1})}$$

and accordingly the decrements in the third year of service are, for resignation and dismissal, obtained by multiplying the $l_{[x-2]+1}$ value by

$${}^{rw} q_{[x-2]+1} \quad \text{and} \quad {}^{aw} q_{[x-2]+1} \quad \text{respectively.}$$

All other decrements are numerically equivalent to the decrements at the same age in the ultimate column, and the result is that the rates for death and disability in the second year of service are represented by the ratios:

$$\frac{d_{x-1}}{l_{[x-2]+1}} \quad \text{and} \quad \frac{{}^i r_{x-1}}{l_{[x-2]+1}}.$$

By continuing this process the select table may be carried back to the first year of service.

The service table is of the form shown on page 430.

That this method automatically causes a reduction in the death and disability rates in the select years of experience is apparent. Therefore, it can be applied only when the service warrants the assumption that there is a slight increase in the rate of death and disability with increase in years of service. The assumption is generally a fair one even where no medical examination of appointees may be made, as there is a certain selection which takes place at appointment, since it is not to be supposed that an appointing officer will employ a man who is not apparently in good health.

This form of service table effects a very great saving of time over what is required if a valuation be made on a select table developed in the customary manner. Of course, select commutation columns involving the number living are necessary, but where no benefits are payable upon resignation or dismissal all benefits can be valued on single sets of commutation columns based on the ultimate numerical values common to all periods of service. In some services which have distinct benefits payable upon death in performance of duty, death from other causes, disability in performance of duty, disability from other causes, and service retirement, there is sometimes a very great saving in the amount of labor which would ordinarily be required in the preparation of commutation columns and in the actuarial valuation work.

PENSION FUND ACTIVE SERVICE TABLE IN SELECT FORM.

Age.	Living.				Withdrawals.									Deaths.	Separations by Disability.			Service Retirement.
					Resignations.				Dismissals.				Total Ultimate.		In Performance of Duty.	Other Causes.	Total.	
	l_x	$l_{[x-1]+1}$	$l_{[x-2]+2}$	l_x	r_{w_x}	$r_{w_{[x-1]+1}}$	$r_{w_{[x-2]+2}}$	r_{w_x}	d_{w_x}	$d_{w_{[x-1]+1}}$	$d_{w_{[x-2]+2}}$	d_{w_x}	w_x	$d_{[x]}^{[x]}$ $d_{[x-1]+1}^{[x-1]+1}$ $d_{[x-2]+2}^{[x-2]+2}$	$o_{[x]}^{[x]}$ $o_{[x-1]+1}^{[x-1]+1}$ $o_{[x-2]+2}^{[x-2]+2}$	$o_{[x]}^{[x]}$ $o_{[x-1]+1}^{[x-1]+1}$ $o_{[x-2]+2}^{[x-2]+2}$	$t_{[x]}^{[x]}$ $t_{[x-1]+1}^{[x-1]+1}$ $t_{[x-2]+2}^{[x-2]+2}$	o_{r_x}
20	1,000,000				47,000				62,200					3,849	46		46	
21	975,932	886,905			44,990	33,968			84,516	41,507				3,870	49		49	
22	959,536	842,507			43,659	30,920	24,952		106,029	49,624	37,550			3,896	53		53	
23	922,621	805,899	758,014	741,060	41,334	28,287	21,755	17,155	110,622	57,219	38,810	26,456	43,611	3,935	58		58	
24	871,486	766,872	716,400	693,456	38,258	25,760	18,985	14,043	104,840	58,574	38,112	20,110	34,153	3,994	60		60	
25	812,098	724,334	678,284	655,249	34,920	23,179	16,618	11,827	91,605	54,325	35,543	17,299	29,126	4,076	69		69	
26	752,352	681,428	642,685	621,978	31,712	20,988	14,653	10,013	76,138	46,473	31,492	15,425	25,438	4,136	75		75	
27	697,917	640,291	609,756	592,329	28,859	18,696	12,805	8,411	61,137	37,778	27,012	13,970	22,390	4,223	84	11	95	
28	651,691	603,603	579,499	565,621	26,393	16,901	11,242	7,183	49,073	30,301	22,659	12,840	20,023	4,293	94	19	113	
29	614,111	571,819	551,995	541,192	24,441	15,325	9,936	6,213	40,900	24,988	18,878	11,798	18,011	4,345	107	56	163	
30	583,825	544,262	526,998	518,673	22,828	14,042	8,906	5,447	35,905	21,226	15,810	10,944	16,391	4,372	119	192	311	
31	557,404	520,409	504,311	497,599	21,349	13,010	7,918	4,822	32,273	18,839	13,717	10,101	14,923	4,369	134	413	547	
32	533,873	498,866	483,644	477,760	20,020	12,023	7,162	4,300	29,737	17,460	12,338	9,316	13,616	4,362	153	707	860	
33	512,246	478,894	464,161	458,922	18,953	11,206	6,498	3,910	27,508	16,522	11,233	8,582	12,492	4,323	172	883	1,055	
34	491,739	460,407	445,788	441,052	17,899	10,497	5,884	3,551	25,718	15,792	10,254	7,851	11,402	4,247	189	1,090	1,279	
35	472,683	442,596	428,592	424,124	16,922	9,781	5,357	3,236	24,532	15,049	9,558	7,211	10,447	4,186	203	1,281	1,484	
36	453,232	425,559	412,096	408,007	15,954	9,150	4,904	2,962	22,571	14,383	8,736	6,589	9,551	4,125	211	1,421	1,632	
37	435,411	408,950	396,269	392,699	15,065	8,588	4,478	2,726	21,466	13,495	7,846	6,028	8,754	4,064	216	1,669	1,885	
38	417,885	392,931	380,918	377,996	14,250	8,094	4,114	2,499	20,309	12,378	6,856	5,549	8,048	4,003	218	1,785	2,003	
39	401,294	377,320	366,453	363,942	13,544	7,622	3,774	2,307	19,222	11,055	6,157	5,113	7,420	3,938	217	2,040	2,257	
40	385,369	362,333	352,448	350,327	12,756	7,210	3,524	2,119	18,266	9,783	5,463	4,747	6,866	3,872	213	2,239	2,452	
41	....	348,023	339,016	337,137	....	6,786	3,322	1,949	....	8,701	4,916	4,410	6,359	3,799	206	2,322	2,528	
42	....	....	326,209	324,451	....	....	3,099	1,794	....	....	4,567	4,114	5,908	3,718	198	2,463	2,661	
43	....	....	....	312,164	....	....	....	1,648	....	....	....	3,846	5,494	3,630	188	2,653	2,841	
44	....	....	....	300,199	....	....	....	1,504	....	....	....	3,611	5,115	3,537	177	2,825	3,002	
45	....	....	....	288,545	....	....	....	1,379	....	....	....	3,399	4,778	3,434	164	2,895	3,059	

In valuing it is necessary to multiply the number of persons or their salaries, at any age or length of service, by certain multipliers or reserve values which are derived from the commutation columns. These values are usually expressed as fractions, in which the denominator is ordinarily some form of the symbol D_x . If this be found the case in a valuation, then the number or salaries of persons at age x , with less than one year of service may be divided by the proper $D_{[x]}$ value; those at age x with less than two years' service by the proper $D_{[x-1]}$ value; and so on through the ultimate value D_x , after which all the quotients thus obtained for persons of age x may be added together. The result may then be treated for all values as if we were using an aggregate table and the proper reserve for all persons at that age, regardless of the length of service, may be obtained directly by the application, by way of multiplication, of the appropriate ultimate numerator, if the benefit is not dependent on the employee's length of service. In this case neither the values for the select years nor the values for the ultimate years can be grouped together unless we resort to some arbitrary grouping for the sake of reducing the amount of labor required in the valuation work.

The next method which is presented has to do with the valuation of one of such benefits limited by length of service; namely, a method for valuing regular or service pensions allowed after some definite period of service, as 30 or 35 years, where no definite age limitation is included. To be sure, such benefits may be valued simply as deferred annuities, which assumes that each employee will retire on the completion of the span of service required for eligibility. The deferred annuity basis is safe. If everyone should elect to go out immediately after reaching eligibility there would be sufficient money to grant and pay all annuities. But as a matter of fact everyone does not elect to retire at this time; in fact some would never retire of their own volition. If we value on this basis we would accumulate a fund which in all probability would be very much more than sufficient to pay the annuities actually claimed (since the average length of service will be several years more than the minimum period required), and the rates of contribution required to support the fund would be very much larger than those actually needed to pay the pensions necessary to relieve the service superannuation. Not only is it undesirable from the social viewpoint to have excessive premiums or contributions paid by an em-

ployee between the ages of 20 and 50, but the practical difficulty of reorganizing insolvent pension funds, because of the contributions required of employee or employer, requires that the transition from a period of hopeless insolvency to one of absolute solvency be made as easily as possible.

We must therefore resort to a rate of service retirement just as we have a rate of disability retirement; however, such a rate cannot be handled in the same manner as is the rate of disability. Disabilities may be expected to occur without regard to the pension allowances, as they are dependent on vital conditions which we may assume would have been prevented if possible and which will occur whether the pension be granted or not. But service retirement is quite different; obviously there could be no service retirement if there were no pension, and consequently no rate of retirement until the employee enters the period of eligibility for pension. This again brings up the question of the necessity of treatment on a select basis.

The problem is admirably stated by Mr. E. C. Thomas, of the Institute of Actuaries, in a discussion before the members of that body in the meeting of June, 1908. He said, in part, "Assume that a pension was given according to scale or retirement after fifteen years' service . . . and it was required to know the rate of contribution for an entrant aged 50. The aggregate service table on which calculations were based would show a very large number of retirements between the ages of 50 and 65, so that the number of survivors at 65 debited with a pension would be comparatively small, but in the commutation column for obtaining the value of the benefit for the entrants at age 50 one would ignore all the retirements under 65, for the rules said that those should have no benefit, and the column aC_x would commence at that age. Thus, full credit would be taken for the diminution in the number of survivors caused by the early retirements, without allowing for any compensating benefits. The probability was that the rate of retirement in such a case would be practically nil, and in order to get a proper estimate of the cost the retirements assumed in the aggregate service table ought to be put back into the l_x column for that purpose, so that those of them who survived the mortality risk would be assumed to take out, at 65, the pension to which they were then entitled." (*J. I. A.*, Vol. XLII, p. 63.)

In valuing service pensions based on length of service the Com-

mission on Pensions used a method which apparently performs what Mr. Thomas suggested. Had his writing been at hand when the formulae were prepared, the author probably would have asked for his criticism of the method, but unfortunately it did not come up in this connection until recently, when one of the members of the staff went through the books in the office to see if the methods herein described had been suggested or covered in papers before any of the societies.

The method of accomplishing the desired result is as follows: A supplementary column is constructed in connection with the column showing the number living of the active service table, which carries forward those who are shown by the table to retire. In bringing them forward they are assumed to be subject to the risk of death only. The group at age x in the supplementary column is denoted by the symbol

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

The rate of retirement in the first year of eligibility by this method is

$$\frac{{}^o r_x + {}^o r l_x}{l_x + {}^o r l_x}$$

and in the ages of eligibility after the first year it is $\frac{{}^o r_x}{l_x}$.

Commutation columns were developed on the basis of this column as follows:

$${}^o r_1 D_x = {}^o r l_x \cdot v^x,$$

$${}^o r_1 N_x = \sum_{x=x+1}^{x=\omega} {}^o r_1 D_x,$$

$${}^o r_1 C_x = {}^o r l_x \cdot v^x \cdot \bar{a}_x.$$

The symbol " ω " is used to indicate the highest age in the table under consideration.

The present value at entrance of a pension of one to the employee described by Mr. Thomas, entering at age 50 and being required to serve fifteen years before retirement, becomes in columnar values

$$\frac{{}^o r \bar{M}_{65} + {}^o r_1 C_{65}}{D_{50} + {}^o r_1 D_{50}},$$

where

$$\begin{aligned} {}^{or}\bar{M}_{65} &= \sum_{x=65}^{x=60} {}^{or}\bar{C}_x, \\ {}^{or}\bar{C}_x &= {}^{or}r_x \cdot v^{x+1} \cdot \bar{a}_{x+1}, \\ D_{60} &= l_{60} \cdot v^{60}, \end{aligned}$$

and the contribution rate per year would be

$$\frac{{}^{or}\bar{M}_{65} + {}^{or}C_{65}}{N_{60-\frac{1}{2}} + {}^{or}N_{60-\frac{1}{2}} - {}^{or}N_{65-\frac{1}{2}}}.$$

Without some sort of an adjustment of this nature in the use of an aggregate retirement rate, the cost of the retirement benefit will be greatly underestimated. Undoubtedly, the most advisable method of valuing benefits under these conditions would be to use select tables, but this would require a table for each age at entrance. This would mean from ten to twenty or more tables which, because of the many commutation columns, reserve values, etc., required, would be almost impracticable; while on the other hand, the possibility of obtaining an experience large enough to give an actual basis for such a set of tables is very remote. 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. How to handle the retirement rate depends, of course, upon the service under investigation. In services where the minimum and maximum ages of entrance are close together and very few enter the service at ages much in advance of the average entrance age, the method just explained will be found probably to apply very satisfactorily.

On the other hand, in services where there are no limitations on the age at entrance and the dispersion around the average age at entrance is very great, then the method explained above will probably somewhat understate the liability.

The Pension Commission, in showing the liability of the city as regards pensions, preferred rather to understate than overstate the liability, since the purpose of its report was to show, not what the now insolvent systems might cost if continued, but rather what the probable minimum amount would be; that is, what the city and employees would actually have to provide as a minimum in order to prevent the collapse of the systems. If the problem involves the

valuation of a fund in a healthy condition, or the calculation of rates for a reorganized fund, where the desire would be to keep the fund on the side of safety, then the rate of retirement must be arbitrarily increased to what might be considered a proper ultimate rate of retirement, or might better be prepared from the experience from which all persons who have not been eligible for pension for at least one year have been excluded. This will give an ultimate rate of retirement which might be used in place of the aggregate rate in the construction of the aggregate service table. The rate for the first year of eligibility will be supplied automatically by the mechanical action of the formula suggested.

If an ultimate rate which is higher than the aggregate be employed as suggested, the results obtained will ordinarily tend to overstate the liability and be entirely on the side of safety. If the experience will permit, the method may be tested before being used and the extent of the overstatement will be known. If necessary, an adjustment may be made in the oC_x value which will so modify the action of the formula as to make it reproduce the experience at hand; however, this is generally not possible in small funds. In small funds it may not seem advisable to tabulate the data in a form which will furnish more than a set of aggregate rates. If so, an ultimate rate may be adopted as reasonable by estimating from the age and service distribution of the active service about what proportion of the exposure in the older ages is on account of persons who have reached the period of eligibility and then modifying the aggregate rate accordingly. If this rate be used the method just described will probably give satisfactory results, even if no modification be made in the oC_x value, because it will not produce reserves or contribution rates as high as the deferred annuity method, and yet will safely overcome the danger which has been pointed out by Mr. Thomas.

The method is set forth simply as one of several mechanical methods of dealing with this type of benefit. This benefit presents many difficulties which are not found in valuing funds having age limitations on pensions, since where the regular pension is limited by service it cannot be considered apart from the other benefits of the fund. For example, if the period of service necessary for eligibility be changed, the values or contribution rates for disability pensioners are thrown out as the change will affect the number of disability cases, and so on; a reduction in the disability allowances

will in turn throw out the service pension rates, and changes in either will affect the death benefit premiums and may change the whole form of the formula employed to calculate the cost of return contributions premiums, if such are included.

Because of these practical difficulties the application of the following method of valuing service pensions does not always seem advisable. However, it is believed that this method affords a more scientific means of valuing pensions of this type than any other that has been presented. It is as follows:

The active service experience of the fund is divided; all the experience relating to years of service prior to the period of eligibility is considered in one group, and all the experience of the employees after reaching the period of eligibility is considered in another. From the experience of the first group a service table is prepared in the customary manner. This table will of course not show a service retirement column, since no rate of service retirement can be developed from the experience of employees prior to eligibility. From the remainder of the experience, that is, for the experience of employees after reaching the age of eligibility, another table is prepared similar in form to the active service table. The entrants into the experience used as a basis for this table will not be entrants into service but entrants into the period of pension eligibility, and if there be a very high rate of retirements in the first few years of eligibility then this table may be prepared on a select basis. If this be done the method of construction may be similar to the method suggested earlier in this paper. Upon this second table commutation columns may be prepared, as follows:

l'_x = number living at age x in second table,

${}^o r'_x$ = number of retirements between ages of x and $x + 1$,

$D'_x = l'_x \cdot v^x$,

$N'_x = \sum_{x=x+1}^{x=\infty} D'_x$,

${}^o r \bar{C}'_x = {}^o r'_x \cdot v^{x+\frac{1}{2}} \cdot \bar{a}_{x+\frac{1}{2}}$,

${}^o r \bar{M}'_x = \sum_{x=x}^{x=\infty} {}^o r \bar{C}'_x$.

Of course, if the table be prepared in select form these values will be based on the select table. If these commutation columns

be prepared they may be used in connection with the first active service table, by the combination:

$$\begin{aligned} {}^r\bar{C}_x &= l_x \cdot v^x \cdot ({}^r\bar{M}'_x \div D'_x), \\ D_x &= l_x \cdot v^x. \end{aligned}$$

The solution of the present value of a pension of one to the employee entering service at age 50, and eligible to retire in fifteen years, as cited by Mr. Thomas, would be by the use of this method:

$$\frac{{}^r\bar{C}_{65}}{D_{50}},$$

and the contribution rate would be:

$$\frac{{}^r\bar{C}_{65}}{N_{50-\frac{1}{2}} - N_{65-\frac{1}{2}} + \frac{l_{65}}{l'_{65}} N'_{65-\frac{1}{2}}}.$$

These formulae are simpler than the approximate formulae involving the ${}^r l_x$ column, which were referred to above, as regards the service limitation, but their use necessitates the employment of slightly more complicated methods of valuing the various disability and death benefits which may be included in the fund. However, their use will probably give the best results where the experience is broad enough to permit of their application.

The technical problems of pensions today present their difficulties to the actuary, but these will probably be met, and as the many different systems present themselves with their varied ramifications, the methods will be modified and improved until we will have eventually reached a period where methods will be as clean cut and as general in their application as ordinary life insurance formulae.

But there are other problems of a non-technical nature to be solved by the Pension Commission. The valuation of each fund has now been completed and the total liability of the entire system determined. In round numbers such liability is \$216,000,000. Of this amount \$9,000,000 is provided by employees' contributions, and there remains a deficiency of \$203,000,000 after deducting the funds in hand. Possibly \$30,000,000 will be available from the indirect contributions of the city to cover this.

What will be done? Will the results of the Commission's work be used as a basis for building up a new system which will have the

assets adjusted to the liabilities and which will protect both the city and the employees against superannuation, or will the present funds be allowed to drag along, accumulating an ever-increasing liability until they come to the point where they cannot even meet matured obligations, as is now the situation with the teachers' pension fund?

Reorganization of the entire system will present many difficulties, not only from the technical standpoint, but in bringing the employees to realize that a solvent fund offers more advantages to them than the present one. This difficulty is aggravated by the fact that contributions from employees will probably be required or else the benefits provisions will be reduced. The systems have already accumulated such liabilities that it is difficult to see where the city can find the money to finance the systems even with the help of employees.

Probably the system can be properly reorganized for new entrants, as here the great problem of accrued liabilities need not be considered. By means of meetings and conferences with employees it may be possible to show them the conditions, and with the help of those employees who are sufficiently interested to really study the matter and obtain the facts for themselves, the Commission may be able to assist in placing all of New York City's pension systems on a rock bottom foundation.

However, the reorganization of the schemes marks but the beginning of the equally important work of keeping funds that are established on the right basis in a perpetually solvent condition. The administrative work of the funds must be properly organized, the proper record systems for the accounting work and for the accumulation of data necessary for actuarial valuations must be prepared.

The actuarial work is still to be continued. Means must be devised for valuing the experience of each fund as it grows. In the initial valuation it is often impossible to obtain a complete basis to forecast future rates. A fund changes as it grows. Changes of administration, and the fact that the fund is on an organized basis alone gives reasons for changes to be expected in the various rates used in valuation. As the forces which determine the rates of contribution can be more closely determined, the rates should be adjusted and the entire solvency of the fund tested. 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 bene-

ficiaries 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. But this is anticipating the future. The funds have not yet been reorganized on a scientific basis, and it is only by the help of the employees and the taxpayers, led by those who appreciate the significance of these conditions, that reorganization will come to pass.

A PRELIMINARY TEST OF THE COAL MINE RATING SCHEDULE OF THE ASSOCIATED COMPANIES.

BY

E. H. DOWNEY.

The present paper is not designed as an original contribution to the theory of schedule rating, nor even as a critical discussion of the particular schedule rating plan here under review. It professes to do no more than present the salient results of that plan as revealed by the first inspection of coal mines in Pennsylvania. The interest of these results lies in the novelty of the plan itself, and in the fact that similar statistics relative thereto have not heretofore been published.

Compensation insurance of coal mines in Pennsylvania is confined to the Associated Companies, the State Workmen's Insurance Fund, and the Eureka Casualty Company (which insures only the properties of a particular mining corporation). Partly because of the limited number of competing carriers, and partly because the Associated Companies had already perfected machinery for the purpose, an arrangement was made whereby the inspection department of the Associated Companies acts, for the present, as a central bureau for the inspection and rating of coal mines. The agreement provides that the service rendered by the said inspection department to the State Fund shall be identical in every respect* with that to the Associated Companies, and that its operations shall be subject to the direct supervision and visitation of the Insurance Department.

In pursuance of this arrangement, some fifteen hundred first inspections have been reported to the Insurance Department. Of this number, 1,135 are included in the present survey.† A further

* That is, as respects schedule rating inspections and re-inspections.

† State Fund risks are omitted because written at a different base rate so that a re-computation would be required to make the results comparable. A number of inspection reports, moreover, were received too late to be included in the tables. In a later number of the *Proceedings*, I expect to publish a full summary of all coal-mine inspections and re-inspections.

deduction is to be made of 215 minimum risks,† leaving 920 mines on which the returns are given. Table I shows the payroll, premium, number of employees and average annual earnings, as indicated on the inspection reports and policy proposals for both anthracite and bituminous mines. These figures are of course to be read in the light of their source as advance estimates only. Still, they serve to indicate the extent of exposure involved.

TABLE I.
EXPOSURE OF RATED MINES.

Classification.	Number of Risks.	Payroll.	Premiums at Base Rate.	Number of Employees.	Average Annual Earnings.
Both.....	920	\$52,552,100	\$2,105,033	92,400	\$569
Anthracite....	75	11,393,900	528,675	20,400	559
Bituminous...	845	41,158,200	1,576,358	72,000	573

To explain the rating returns upon these risks, it is necessary to recall the principal features of the Associated Companies' schedule. It will be remembered that the schedule consists of charges only‡ expressed in points which are convertible into premium rate by a simple algebraic formula.* The charge values are derived from statistics of fatality rates by accident causes as compiled by the United States Bureau of Mines. There are some 148 specific items all told, arranged in twelve groups as shown by Tables IV and V. By no means the least interesting feature of the schedule is the device for securing a balance of premium income with basis rate. The base rates on coal mines, as on other classifications, are intended to cover the expected aggregate losses. Hence schedule

† Less than \$100 premium for bituminous, or \$200 for anthracite mines.

‡ See paper by H. M. Wilson, *Proceedings*, Vol. II, p. 39.

* $y = B(1.00 - U) + x(UB/L)$, where B is base rate, U = maximum reduction (in per cent.) from base rate, L = normal charges, x = charges on specific risk, y = rate sought. For Pennsylvania $B = \$4.64$ for anthracite and $\$3.83$ for bituminous mines, $L = 30$ for anthracite and 25 for bituminous mines, $U = 40$ per cent. of base rate. Substituting the formulæ become respectively:

$$y = .60B + x \frac{.40B}{30} \quad \text{and} \quad y = .60B + x \frac{.40B}{25}$$

or

$$y = \$2.78 + x \frac{\$1.86}{30} \quad \text{and} \quad y = \$2.30 + x \frac{\$1.53}{25}$$

rating should affect a redistribution of premium income without altering its total amount. In a schedule of charges only this result was sought by determining the number of charge points which would apply upon a "normal" or "average" mine, and fixing the neutral point of the schedule at such number. For Pennsylvania these norms are 25 points for bituminous and 30 for anthracite mines. That is to say, if the total charges upon a bituminous mine are 25 points, the mine will pay the basis rate; if the charges are zero, the rate is 60 per cent. of manual; if the charges exceed 25, the rate is more than manual. A marked advantage of this plan is that the balance of premium increases and decreases can be readjusted at any time by changing the norms without affecting the charge items or their values. This feature should especially commend itself to those who have wrestled with the problem of correcting the effect upon premium income of the Universal Analytical Schedule.

Tables II and III show to what extent this device accomplished the desired results. It will be seen that the schedule produced an approximate balance upon the first inspections of bituminous mines, the aggregate departure from manual premium being barely 2 per cent. The net reduction was much greater upon anthracite mines, viz., 8.4 per cent. of base rate. Taking both classes together, the net reduction from manual premiums was 3.7 per cent.—a remarkably close balance. By reference to the charge groups it will appear that the normal of 25 charges is approximately correct for bituminous mines, whereas the anthracite norm of 30 charges seemingly is pitched too high. In point of fact the weighted average charges actually developed were nearly identical for anthracite and bituminous mines.* A very commendable result is the small dispersion in both tables. A majority of the risks, and the bulk of the payrolls and premiums, fall within the groups just above and below the basis rate. The number of maximum reductions, as also the number of increases of more than 30 per cent., is extremely small. No single risk produced more than 58 charges, or

* Since this paper was prepared Mr. H. M. Wilson has explained that the normal charge of 30 upon anthracite mines was purposely fixed too high with the intention of reducing aggregate premium income as compared with base rate. The base rate was computed from statistics of accidents compiled for a period when the mine law applicable to anthracite mines was less stringent, and the hazards (presumably) greater than at present. The schedule was used to correct a presumed excess of base rate.

an increase of 51 per cent. over manual. Be it remembered that there are no arbitrary stop limits to control charges and credits, so that this result is due purely to the shrewd selection of charge values.

TABLE II.*
RATE DISTRIBUTION OF ANTHRACITE MINES.

Rate Group.	Charge Group.	No. of Risks.	Payroll.	Premium at Base Rate.	Adjusted Amt.	Premium. % of B. R.
Total.....	23.7	75	\$11,393,900	\$528,675	\$484,340	91.6
60- 70%	0- 7	1	30,000	1,392	875	63
71- 80%	7-15	10	320,900	14,890	11,193	75.1
81- 90%	15-23	25	3,391,900	157,382	135,658	86.4
91-100%	23-30	30	6,585,600	305,571	284,486	93.1
101-110%	30-37	7	805,500	37,376	38,588	103
111-120%	37-45	2	260,000	12,064	13,540	112
121-130%	.....	.....	.....	.....	.....	.....
Over 130%	.....	.....	.....	.....	.....	.....

TABLE III.*
RATE DISTRIBUTION OF BITUMINOUS MINES.

Rate Group.	Charge Group.	No. of Risks.	Payroll.	Premium at Base Rate.	Adjusted Amt.	Premium. % of B. R.
Total.....	23.8	845	\$41,158,200	\$1,576,358	\$1,543,322	97.9
60- 70%	0- 6	7	39,300	1,505	1,007	67.1
71- 80%	6-13	59	1,447,400	55,437	42,607	76.9
81- 90%	13-18	202	9,339,200	357,693	304,073	85
91-100%	18-25	316	12,774,800	489,273	467,949	95.6
101-110%	25-31	201	12,738,400	487,881	505,269	103.6
111-120%	31-37	44	3,298,300	126,326	143,602	113.7
121-130%	37-44	9	662,300	25,364	31,551	124
Over 130%	Over	7	858,500	32,879	47,264	144

How far the balance of premium income will be affected by reinspection cannot, of course, be determined until the reinspections have been made. It should be stated, however, that the schedule was designed to produce a balance upon first inspections. That is to say, the normal charges were intended to reflect the conditions of unimproved mines and not of mines improved by the effects of

* In the above tables Column 1 shows the rate groups in per cent. of base rate and Column 7 shows the adjusted premium in per cent. of manual premium. Column 2 shows the charge limits, in points, for each group, while the first line gives the weighted average charges upon all risks.

schedule rating. This procedure was logical, since the basis rates were calculated altogether from accident statistics which antedated the Compensation Act, and the introduction of schedule rating. It is to be expected, therefore, that the reinspections will show a considerable reduction from basis rates, consequent upon the removal of conditions for which charges were made in the first inspections. To offset such reductions the framers of the schedule hope that the correction of these conditions will produce a corresponding decrease in the number and severity of injuries. How far this hope will be realized time alone can tell.

Tables IV and V exhibit the charges developed upon first inspections in points and in per cent. of the total, by item groups. Safety measures (Item II), it should be explained, comprise warning signs, illumination, signal system, refuge chambers, escape ways, mine maps, rescue crews, first aid and hospital provisions and toilet facilities. The other titles are self-explanatory. It will be observed that there is a fairly close correspondence between the per cent. of total charges actually developed and the state weights. The closest correlation is found in the most important group of charges—those for conditions affecting falls of roof and coal. The widest discrepancy appears in the two "moral hazard" groups (I and II). It must be owned that many of the items in these groups are too vague to admit of uniform or accurate applications. The deficit of realized, as compared with expected, charges in Group I, is accounted for, in large part, by the waiving of charges in doubtful cases. There is a rather consistent deficit in the minor items, the exact meaning of which is not altogether clear. Taken as a whole, however, the correspondence is remarkably close, which goes to say that the schedule faithfully reflects actually existing conditions in Pennsylvania mines.

Unfortunately, considerations of time and space forbid the insertion of similar tables exhibiting the charge items in detail. Such detail would show that barely 10 per cent. of the total standard charges are for conditions not within the control of the operator.* The schedule thus provides an important prerequisite to the use of schedule rating for accident prevention. Quantitatively, however, the charges are based purely upon the insurance value of the hazards involved, without reference to the cost of correcting defects.

* These charges are on Items 26, 61, 63, 107, 111 and 112.

How far the charges will prove effective can only be determined from the results of inspections.

To conclude, this preliminary test indicates that the Associated

TABLE IV.*
CHARGES UPON ANTHRACITE MINES.

Items.	Reduced Charges.	% of Total Charges.	State Weights.
All items	169,728	100	100
I. Safety organization.....	23,480	14	20
II. Safety measures.....	55,760	33	20
III. Surface hazards.....	9,779	6	8
IV. Shaft hazards.....	2,379	1.4	3
V. Underground haulage.....	7,424	4	8
VI. Falls of roof or coal.....	42,575	25	25
VII. Explosives.....	19,934	12	6
VIII. Electricity.....	249	—	2.5
IX. Mine gas.....	4,627	3	4.5
X. Coal dust.....	0	—	—
XI. Mine fires.....	767	.5	.5
XII. Miscellaneous underground hazards...	2,754	1.6	2.5

TABLE V.*
CHARGES UPON BITUMINOUS MINES.

Items.	Reduced Charges.	% of Total Charges.	State Weights.
All items.....	1,845,859	100	100
I. Safety organization.....	205,950	11	20
II. Safety measures.....	674,880	37	20
III. Surface hazards.....	32,690	1.8	2.5
IV. Shaft hazards.....	4,971	—	1.5
V. Underground haulage.....	139,005	7.5	9
VI. Falls of coal or roof.....	649,068	35	34
VII. Explosives.....	37,193	2	1
VIII. Electricity.....	6,475	.3	1.5
IX. Mine gas.....	26,187	1.5	3.5
X. Coal dust.....	56,960	3	5
XI. Mine fires.....	4,378	—	.5
XII. Miscellaneous underground hazards....	8,102	.4	1.5

Companies accurately forecast the working of their schedule. It produces an approximate balance of premium increases and decreases upon first inspections and it distributes the total charges

* Reduced charges are 100 times the final value of the charges in points. State weights are the standard relative values of the respective items for Pennsylvania.

among the several items in nearly the proportion intended. All this argues a careful statistical and engineering study of the coal mining industry upon the part of the schedule makers. It remains only to add a word of caution against basing any final conclusions upon the results of a preliminary test. The balance of premium increases and decreases does not prove that the charges accurately reflect the insurance value of the hazards charged for: that can be established only by accurate statistics of compensation cost by accident causes. Similarly, reinspections will not determine the effectiveness of the schedule for accident prevention. The reinspections will show whether and how far certain definite conditions have been remedied, but any resulting decrease in accident frequency and severity must be measured by accident statistics carefully kept and compared over a series of years.

OUTLINE OF A METHOD FOR DETERMINING BASIC PURE PREMIUMS.

BY

ARNE FISHER.

“We assert that what is really statistical work must be undertaken only by the adequately trained statistician and that when it is not, then the investigation cannot be considered as falling into the field of science.”

(Karl Pearson, *Biometrika*, Vol. X, page 172.)

I. INTRODUCTORY REMARKS.

In reading over the first volume of the *Proceedings* of our Society, one will readily notice that the subject of social insurance in its various forms and aspects is still in its infancy in this country. Our newly formed organization has, however, already done valuable service in bringing together and crystalizing a number of problems under this particular branch of insurance. In fact, the majority of papers read at previous meetings have been in the nature of stating rather than of solving problems. The technique of our science is as yet in a somewhat crude state, and the splendid attempts of several members of this body to build up a theory on a sort of mathematical basis, I think, are as yet in an essentially empirical state and do not constitute the final word in the matter. I do not make this statement in a spirit of hostile criticism as I readily realize that dire necessity rather than lack of mathematical knowledge have driven such investigators to adopt essentially empirical formulas and methods. The passing of workmens' compensation acts in a number of states during the last few years has put a vast project before the American insurance world and makes in the complete absence of compact data upon which to construct reliable and just rates, the efforts of those gentlemen highly commendable. They have, in fact, done pioneer work in clearing the forest of the trees and given us a clear view of the lay of the land. A lot of snaggy brush and undergrowth remains still in the ground, however, and must be removed before we can start to till the virgin soil in a systematic manner. In clearing the soil of such snags we must look out for the future and make the task for the plowman as easy as

possible by leaving no holes and pitfalls in the cleared ground. The time has about arrived at which the proposed methods ought to be advanced enough to be subjected to the test of a critical analysis and systematic statistical methods substituted for the preliminary empirical rules and made the basis for future research work in social insurance.

The investigation of causal relation between various social and economic phenomena presents many pitfalls to the uninitiated and offers many opportunities for fallacious conclusions. The statistician in investigating the effect of a multitude of causes working on a single object or group of objects as to a certain attribute cannot narrow himself down to the relatively simple issues of the physicist and the chemist, who in most cases are able to investigate the variations as to a certain attribute from a single cause. In view of the complexity of the problem 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. Your future work falls in quite a different field of statistical science than the work of an actuary of a life insurance company. The task of the latter falls essentially inside that division of statistical methods, which Charlier has called *homograde statistics* (*alternative statistics*). In life insurance we deal mainly with two alternative and easily distinguishable contingencies, life or death, which allow a sharp and easy division by a dichotomous judgment. As far as the actuary is concerned there is no such thing as a half dead person or even a half shot person. When turning to the subject of invalidity, we encounter, however, quite a different state of affairs. We may of course easily distinguish between active healthy persons and disabled persons, but the latter do by no means present a compact homogenous group. The degree or intensity of invalidity is a variable factor and belongs to the second great division of statistical methods, the *heterograde statistical series*. It is in this latter branch that during the last

ten to fifteen years we have witnessed the splendid development under the able and energetic leadership under such men as Pearson, Elderton, Edgeworth and Yule of England, Westergaard, Charlier and Kjaer of Scandinavia, Tschuproff and Nekrasoff of Russia and Kapteyn of Holland and a host of other brilliant investigators.

II. THE TEST OF THE STABILITY OF STATISTICAL SERIES.

Statistical science or methods as I view them fall in two parts: the collection of data and the analysis of such data by means of mathematical-statistical methods. It is with the latter part I will deal exclusively in this paper. A mere collection of statistical data, as for instance the data in a census report, means little beyond giving a faithful picture of the past and present conditions of a certain community. We would, however, be very wrong in assuming with Stuart Mill that such picture would remain essentially the same in the future and draw conclusions as to the future by mere induction. It is quite true that many statistical series remain practically unaltered both as to time and to space, but the majority are subject to fluctuations. Before using collected statistical series as the basis of predictions of future events, we must first of all investigate the stability of such series.

Here in America the starting point in compensation premiums or rate making has been a classification pure premium defined by the symbolic formula: $\pi = L/P$ (Losses \div Payroll). When observations of this kind are published it is seldom necessary or even convenient to publish the primary lists in their original form, but the whole experience (population) is divided into sets (samples) of payrolls consisting of say

$$P_1, P_2, P_3, \dots P_N$$

monetary items. Now let in the same manner

$$L_1, L_2, L_3, \dots L_N$$

represent the corresponding losses to each of the observed sets. We then have a certain kind of statistical series:

$$L_1, L_2, L_3, \dots L_N$$

which is called a *homograde* statistical series. The members $L_1, L_2, L_3, \dots L_N$ are called the *elements* of the series and the correlated numbers $P_1, P_2, P_3, \dots P_N$ are called the *numbers of comparison*.

It lies now close at hand to regard the ratio L/P inside a singular classification in the light of a constant mathematical probability whose numerator expresses the unfavorable events (losses) while the denominator gives the total possible cases (total payroll). If such actually was the case, then the series $L_1, L_2, L_3, \dots, L_N$ of the various sample sets inside a particular classification would represent what in homograde statistics is called a *Bernoullian Series*, corresponding to a series of samples of drawings of variously colored balls from an urn. In such series we could a priori by means of a simple mathematical formula predict the magnitude of the fluctuations from the average value from set to set. The older school of statisticians regarded such an identity between a statistical series and a Bernoullian Series almost as an axiom, and even many modern statisticians hold a similar view. As far as I can judge the previous writers on the subject both in the *Transactions* of the Actuarial Society of America and also in the *Proceedings* seem to have taken the same attitude, although they may not be ready to admit so off hand. Is this attitude correct? Or in other words, have we any reasons for assuming an absolute identity between a Bernoullian Series and an actual series in compensation insurance? A priori there exists no earthly reason for such a view except a somewhat mythical belief in the vague term of "the law of large numbers." Somehow or other the belief has crept in that if the exposure is large enough, then the pure premium will also be sufficient. This of course would be true if we were actually dealing with a Bernoullian Series, but as we know all statistical series—even at the best—are approximations only to the Bernoullian form of series. The only way to determine the existence of even an approximate identity between the loss series $L_1, L_2, L_3, \dots, L_N$ and a Bernoullian Series and to establish the stability of pure premiums is by an actual test, and as far as I know no such test has even been attempted in America.

The test of stability is easily made by means of the Lexian-Charlier Theory of Dispersion. Taking the observed losses of various establishments inside the same classification we may find a measure of the magnitude of actual fluctuations inside such classifications by calculating the coefficient of disturbancy. The method is simple and speedy and ought to be applied in definitely establishing the presence or non-presence of stability from year to year or from plant to plant. I am by no means too sure that the test will

establish a state of stability even inside kindred industrial hazards. Thus we know with absolute certainty that the hazard as to fatal accidents in the mining industry by no means is stable and uniform for the whole United States but varies greatly from state to state. On the other hand, states like Iowa and Michigan exhibit actual mathematical imaginary coefficients of disturbancy, indicating very stable conditions from year to year.

III. THE APPLICATION OF THE THEORY OF DISPERSION IN DIVIDING THE MATERIAL IN PROPER CLASSIFICATIONS.

So far I have only discussed the application of the theory of dispersion in testing the stability of the loss series inside a particular classification. I shall next briefly outline how the same method may be used in grouping classifications. As Mr. Mowbray and Dr. Downey have pointed out in their recent contributions, the classifications as to products as employed in most of our previous experiences and state industrial commissions means little or nothing in obtaining a proper estimate of the hazard of an insured object. Take for instance such vast industries as those of the automobile, textile and shoe industries. Each such industrial plant represents a little world all by itself, and it is readily seen that in so far as individual hazards are concerned—or even group hazards of several individuals—the employees represent a decidedly heterogenous mass. From a cursory view it would appear that a workman in the automobile factory foundry is exposed to much greater risks than his fellow worker in the upholstering department. Yet, on the other hand, it seems very plausible that workmen in different industrial plants, performing quite different duties and sorts of labor, nevertheless from the underwriters' point of view present the same insurance risk, and it is thus possible to group workmen from certain parts of the shoe factory with workmen from certain parts of the automobile factory.

It is now the task of the statistician to pick out the individual workmen inside the various plants and group them together in similar classifications of hazards. Once having agreed on the structure of such a group of individuals making a certain classification, we may test its stability by means of the theory of dispersion. If the coefficient of disturbancy is either zero or an imaginary quantity, we know the series is stable. If, on the other hand, it has a large

positive value, then we know that the classification is not homogeneous and will in most cases resort to a further sub-division.

In making such a classification of hazards, I think, it is essential that we limit ourselves to a comparatively small number of classifications, say possibly fifty or sixty. I am quite well aware of the fact that the famous Massachusetts schedule *Z* contains over 1,000 classifications. With due respect for the eminent statisticians and actuaries who have made up this schedule, I dare nevertheless express as my personal opinion that the authors of schedule *Z* have made a sort of classification which is the very antithesis of scientific statistical analysis. It seems to me that these gentlemen have attempted to investigate the variations due from a single cause instead of variations due from a multitude of various causes, the paramount object of statistical methods. In making such a vast classification they have on the other hand gotten stones instead of bread, as it is evident that a very large number of the various classifications will contain such a small number of exposures or numbers of comparison (in this case the amount of the payrolls) that the pure premiums are affected with so enormous errors of sampling that they are absolutely unreliable.

A limited number of classifications is desirable from purely practical reasons and later on for the graduation of pure premiums. I shall take the liberty to illustrate this statement by transgressing on the question of sub-standard risks in life insurance as developed by certain Scandinavian and Austrian actuaries. These actuaries emphasize the importance of a limited number of danger classes and divide the sub-standard applicants into three danger classes for which they construct separate mortality tables with special premiums and reserves. The examining physician simply makes a detailed diagnosis along the lines indicated in the questions on the application blank. The diagnosis enables the actuary to place the individual applicant in the proper danger class. When it is possible to throw the various shades of sub-standard risks into three great classes, I deem it quite possible to limit the number of classifications of industrial hazards to the size as suggested above.

In making such a classification by purely statistical methods I quite readily realize the enormous obstacles which even the most highly trained statistician would find difficult to overcome in the preliminary work in making the first, so to say, rough picking of the various elements. No single statistical expert, no matter how

well trained, has such a detailed knowledge of the numerous and varied industries and trades in America that he is enabled a priori to make such a classification. The number of possible ways into which the various degrees of hazards might be permuted into classifications would theoretically approach infinity and would therefore actually exclude trial classifications taken at random without subjective information as to the character of the risk or hazard in question. I therefore quite agree with Mr. Mowbray's* suggestion to work in harmony with the safety engineer in making a preliminary classification. But I can not follow the same author when he tries to extend his method of personal judgment in rate making in a rather arbitrary manner. Poisson in his celebrated treatise on "Recherches sur les probabilites des jugements" has shown how carefully we must act when relying solely upon personal judgment and subjective information. Moreover the method of "weighting," if it can be called so, by Mr. Mowbray and the proposed modification by Dr. Rubinow shows a so complete disregard of errors due to sampling that it by no means can be considered an improvement over the original judgment percentages of the unit classification rating.

Such arbitrary methods are eliminated when we make use of the dispersion theory in a plan which I shall now proceed to outline. The safety engineers, the inspectors of industrial plants, the owners, superintendents, foremen, etc., of such plants in conjunction with the mathematically trained statistician make first a preliminary survey of the various trades and industries and group the workmen thereunder in some of these fifty above mentioned danger classes. The payrolls are divided accordingly. Also the losses, after being reduced to the same standard of comparison, a process which I shall describe shortly below.

Let

$$\begin{array}{l} L_1, L_2, L_3, \dots L_N \\ P_1, P_2, P_3, \dots P_N \end{array}$$

be such samples of payrolls and losses from various trades and industries which according to the mutual judgment of the safety engineer and the statistician represent the same degree of hazard. In such a homograde series the sample P_1 may possibly stand for a section of the payroll from the glass industry, P_2 a section from the

* *Proceedings*, Vol. II, p. 129.

textile industry, P_3 from the lumber industry, and so forth for the total N samples which according to personal judgment should belong to the same classification and possess the same degree of hazard. Now it would indeed be rash to assume that a first selection would hit the true mark and obtain a classification of perfectly homogeneous hazards where possible variations from industry to industry were entirely due to errors of sampling (variations from chance). Hence it would be fallacious to club all the samples together and form a pure premium as

$$\Sigma L_i / \Sigma P_i \quad (i=1, 2, 3, \dots N),$$

as we in this manner would rely solely upon a subjective judgment. By keeping the original N sample sets separate and applying the mathematical criteria from the theory of dispersion, we may test the stability of the classification and in this way get a purely quantitative measure of the soundness of the engineer's judgment. In this connection I may mention that I have developed a few mathematical criteria entailing the use of the higher statistical characteristics: the coefficient of disturbancy, the coefficient of dependency and the coefficient of variance by which I am able to test not alone the stability of the classification but also to tell in what direction—positive or negative—the safety expert has made errors in estimating the various hazards. As is well known from experimental psychology, subjective judgments of this kind are generally affected with systematic errors.

This plan is similar to that of Mr. Mowbray in making a partial use of subjective judgment. But whereas Mr. Mowbray apparently makes such judgments the basis for actual rate making, the method as suggested above only uses the subjective judgment of the engineering expert in making the first rough picking of the hazardous elements in the homograde series. The test of stability is then done by purely deductive methods and gives us a criterion as to the validity of the engineering judgment in a purely objective manner. Objective statistical methods are thus in the final analysis made the paramount issue and play a much greater role than in Mr. Mowbray's method.

In this manner we obtain an absolutely safe statistical test as to the uniformity and homogeneity of judgment classification of the safety engineer. But right here I wish to emphasize that it would

be advisable to let the dry and dispassionate statistician act as a brake on the sometimes very fertile imagination and enthusiasm of our "safety first" engineers and propagandists. When the safety engineer actually begins to differentiate between an elevator accident and an accident due to slippery floors in entering the elevator, he has indeed made a most serious slip himself in so far as the statistical analysis is concerned, and he has completely slipped away from purely objective research and soared to heights and regions far beyond the horizon of the prosaic statist. If such hair splitting distinctions—mere apples of Eris for the engineer and apples of Sodom for the statistician—must be made the basis for compensation rates, we statisticians may as well pack our kits and leave the field to the undisputed possession of the engineer and "efficiency" expert. In this case I see practically no limits to which such sophistries might be carried. For instance, it would be but a short step to differentiate between floors slippery from oil, butter, axle grease, lemon juice, etc. Even I, as a most dry statistician, have enough poetic imagination to appreciate the new and vast vistas laid open to speculative thoughts by a fertile brain by this method, and I would indeed not be surprised some day to read a serious and learned discussion between safety engineers on the various degrees of hazards of slipping on a banana or a lemon peel. Undoubtedly the safety expert takes himself seriously and regards himself as an essentially practical man. To my simple notion (and here I speak as a former engineer) such finesses appear pedantic rather than practical, and—paradoxically as it may appear—certain safety devices ought to be applied to the safety expert if we really are to follow the "safety first" motto and not drift into idle and extravagant speculations. As a former engineer I quite well appreciate the temptations for the engineer, trained in essentially experimental sciences as physics and chemistry, to try to trace the effect of a single cause. In my early youth, before I obtained a clear understanding, of statistical methods, I held similar views, and first after actual statistical experience I realized that the domain of statistics was the investigation of the effects of a multitude of causes instead of the effect of a single cause on a particular object.

As to the record of losses it must be borne in mind that those items must be reduced to the same standard of comparison. This will of course necessitate a reduction in many cases where the com-

compensation benefits vary according to the different states. I have been assured by several casualty insurance officials with whom I have discussed this matter that such reduction presents no serious difficulties.

A word or two about mean or average rates is perhaps not out of place in this discussion. Somehow or other the belief has crept in, in many statistical investigations, that when the exposure is large we will always obtain a safe "average rate." It must, however, be borne in mind that a large exposure is gained only by sacrificing the homogeneity of the material. The mean value is but a particular value of a large number of variates. If the range of variation is large and fluctuations are marked inside that range, the mean value does by no means present the most probable or even the expected value. It is therefore of the utmost importance to study the fluctuations from the mean from sample to sample. This is exactly what is done in the theory of dispersion. By breaking the large mass up into several samples and computing the higher statistical characteristics of such samples we obtain a safe measure of the dispersion or spreading of the various samples about the mean. In this manner it frequently happens we get much more reliable results out of a small homogenous total exposure than a large heterogenous exposure.

In submitting the above plan for the construction of pure premiums, I do not wish to make any conjectures as to the probable outcome of the test of stability. Possibly the numerical results of the calculation might be of negative value in so far as they might establish that the series was unstable. Such a result—negative as it might be—would, however, be of value in calling our attention to needed reforms of the very principles of rate making. Without making any predictions whatsoever, I think, nevertheless, that the dispersion will establish essentially stable conditions inside homogenous classifications.

The importance and value of the outlined scheme lies, however, in its general application and systematic procedure and in choosing for its basis a purely objective method and analysis in the place of vague subjective judgments and arbitrary rules. Moreover, the method as proposed is built upon an absolutely sound and valid mathematical foundation as developed by the world's foremost experts on statistical methods, which is more than can be said about the methods hitherto suggested in rate making in social insurance in this country.

NOTE.

Since writing this paper I have discussed the matter contained therein with a few casualty statisticians. These gentlemen—although recognizing the purely theoretical value of the method—seem to be of the opinion that it is not feasible to split up the payrolls in the various industries according to the method as outlined above, and they have suggested that I outline a procedure as to the collection of the data necessary for a mathematical analysis. Although my paper dealt exclusively with the analysis of the collected data, I shall nevertheless take the liberty to submit the following short remarks as to the construction of the primary lists from which the homograde series must be constructed.

To begin with, let us consider a certain large and typical industry, such as the automobile industry. The safety engineer, in conjunction with other experts, assigns each individual hazard as represented by the individual employee to one of a limited number of classifications. Each employee is thus assigned to a certain danger class according to the purely subjective judgment of the safety experts and the payrolls are divided accordingly. The losses accruing during the year are likewise distributed among their proper classifications of danger classes.

In this manner we will have N classifications inside the automobile industry (Industry No. 1) with payrolls and losses arranged in the following homograde series:

$$\left. \begin{array}{l} {}^{(1)}L_1, {}^{(1)}L_2, {}^{(1)}L_3, \dots, {}^{(1)}L_{N_1} \\ {}^{(1)}P_1, {}^{(1)}P_2, {}^{(1)}P_3, \dots, {}^{(1)}P_{N_1} \end{array} \right\} \text{No. I.}$$

Again let us take another industry, say the shoe industry (Industry No. 2). Here we also let the safety experts make their classification according to hazards and obtain M classifications of losses and payrolls arranged in the following homograde series:

$$\left. \begin{array}{l} {}^{(2)}L_1, {}^{(2)}L_2, {}^{(2)}L_3, \dots, {}^{(2)}L_{M_1} \\ {}^{(2)}P_1, {}^{(2)}P_2, {}^{(2)}P_3, \dots, {}^{(2)}P_{M_1} \end{array} \right\} \text{No. II.}$$

A third industry, for example the building trades, may yield the following series of R classifications:

$$\left. \begin{array}{l} {}^{(3)}L_1, {}^{(3)}L_2, {}^{(3)}L_3, \dots, {}^{(3)}L_{R_1} \\ {}^{(3)}P_1, {}^{(3)}P_2, {}^{(3)}P_3, \dots, {}^{(3)}P_{R_1} \end{array} \right\} \text{No. III.}$$

Continuing in the same manner we may easily obtain fifty or more typical sample classifications from various industries.

These primary lists are now at the completion of the calendar year submitted to the statistician. The losses are reduced to a common hypothetical standard of payroll P . Such reduction requires in most cases a certain correction on account of errors from sampling, which, however, may be taken care of by applying certain well-known criteria from the theory of probabilities.

After having reduced the loss series to a common standard of payroll we obtain the following *reduced* homograde series:*

$$\begin{array}{ccccccc} {}^{(1)}L_{1,1} & {}^{(1)}L_{2,2} & {}^{(1)}L_{3,3} & {}^{(1)}L_{4,4} & \dots, & & \\ {}^{(2)}L_{1,1} & {}^{(2)}L_{2,2} & {}^{(2)}L_{3,3} & {}^{(2)}L_{4,4} & \dots, & & \\ {}^{(3)}L_{1,1} & {}^{(3)}L_{2,2} & {}^{(3)}L_{3,3} & {}^{(3)}L_{4,4} & \dots, & & \\ \dots & \dots & \dots & \dots & \dots & & \\ {}^{(50)}L_{1,1} & {}^{(50)}L_{2,2} & {}^{(50)}L_{3,3} & {}^{(50)}L_{4,4} & \dots. & & \end{array}$$

It is now the statistician's task to pick out and combine such values of the various L 's so that we shall finally have a limited number, say possibly sixty or less classifications of hazards.

Let one of those picked classifications contain the following samples of L :

$${}^{(1)}L_{10}, {}^{(2)}L_6, {}^{(3)}L_{24}, {}^{(4)}L_9, \dots, {}^{(50)}L_{12}.$$

This means that ${}^{(1)}L_{10}$ (classification No. 10 of the automobile industry, Industry No. 1), classification ${}^{(2)}L_6$ (classification No. 5 of the shoe industry, Industry No. 2) and classification ${}^{(3)}L_{24}$ of the building trades and so forth for the various industries, should represent the same hazard. This series is now tested as to stability. If the mathematical criteria are satisfied, the series may be considered as stable and the pure premium expressed as

$$\pi = \frac{\sum L}{\sum P}.$$

If the criteria are not satisfied, it becomes necessary to resort to another grouping of the above reduced series of L . However, any adequately trained statistician will not need to make very many trials before he will be able to produce a stable series, that is, a series which may be considered stable for practical purposes.

* Such a homograde reduced series is as a matter of fact a series of pure premiums for the various sub-classifications.

In conclusion, I wish to state that if any of the members of this Society should feel inclined to undertake a research along the lines indicated in this paper the only requisite is a thorough understanding of the mathematical theory underlying modern statistical methods. *This requisite is essential, however, and without it no valid results will be reached. I might also add that although I have treated the rudiments of the dispersion theory in my book on "The Mathematical Theory of Probabilities" the treatment there is not adequate in this case where certain higher statistical parameters (such as the eccentricity and the excess) must be taken into consideration.* The actual arithmetical computations are quite simple and may be undertaken by any office clerk.

SOME DISTINCTIVE FEATURES OF STEAM BOILER UNDERWRITING, AND THEIR BEARING UPON THE FORMULATION OF PREMIUM RATES.

BY

FRANK M. FITCH.

It is nearly one hundred and fifty years since that great mechanical genius, James Watt, discovered and made practical application of the principles and power of expanding steam for the rotation of a shaft. His simple, crude steam boiler was the forerunner of the great steam power plants that have made possible our present vast manufacturing industries. To what extent the place of steam in the great world of industry is to be supplanted by modern power producers, such as all kinds of internal combustion engines, and electrical energy produced by water power, is open to conjecture. That electricity, which has already made its advent felt in the field of steam boiler underwriting, will ultimately become a very large factor, is probable. As yet, it has not produced any serious effect, and I refer to it here because the use of electricity for power purposes is constantly increasing—a fact that is presumably potent with many possibilities for the future of steam boiler underwriting.

A BRIEF HISTORY.

Steam boiler insurance originated in England. The increasing use of steam power brought with it a growing demand for more thorough and scientific inspections of steam boilers. As a result of a public meeting following a very disastrous boiler explosion in 1854, there was formed in the following year what may be considered the pioneer in this class of business. It is to-day known as "The Manchester Steam Users Association for the Prevention of Boiler Explosions and for the Attainment of Economy in the Application of Steam." No provision was made at that time for covering losses arising from explosions. It is possible that this omission gave rise to the founding in 1859 of the present Vulcan Boiler and General Insurance Company, which was the first company to

supplement the inspection service with an insurance policy. In 1864 the present National Boiler Insurance Company was organized, and has ever since continued under the same title. Two years later, in 1866, the Hartford Steam Boiler Inspection and Insurance Company (the first boiler company in this country) was founded.

This is, therefore, an appropriate time and place for your consideration of the subject of steam boiler underwriting, as both are associated with the fiftieth anniversary of its introduction into this country.

The Hartford company for a number of years wrote business in both the United States and Canada. In 1875 "The Canadian Steam Users Association" was formed, and in the following year it acquired the Canadian business of the Hartford company. It is interesting to note that exactly thirty years later, in 1906, the Hartford again acquired an interest in Canadian business through the Canadian Steam Users Association—the name having in the meantime been changed to that by which it is at present known, viz., The Boiler Inspection and Insurance Company of Canada. Although its policies are guaranteed by the financial resources of both companies, the personnel of the Canadian company, as also its assets, remains Canadian. For seventeen years the Hartford was the only company in the United States conducting this class of business. In 1883 a competitor, known as "The American Steam Boiler Insurance Company," was organized. After a brief and somewhat erratic career the American went out of business.

Although these two companies are the only ones that have been organized in this country to carry on the business of steam boiler underwriting solely and entirely, other insurance companies, particularly those engaged in liability underwriting, have added the writing of steam boiler policies to their other lines. At the present time there are thirteen companies engaged in this class of underwriting.

Great indeed have been the changes in both insurance coverage and practice since the Hartford company was founded in 1866. In those early days the insurance allowed under each policy was small, covering only specified amounts on each boiler, and on the machinery and buildings. Now the insurance under one blanket policy not only covers the property of the assured and the property of others for which the assured may be liable, but also the liability of the assured for loss of life and personal injuries.

Governed partly by a study of the meager experience of those early English boiler companies, though probably largely by their best judgment as to the relationship between the premiums and the cost of inspection, combined with the probable losses, the founders of the Hartford company decided upon yearly rates for premiums varying from 1 per cent. to $1\frac{1}{2}$ per cent., with a minimum yearly premium of \$30. To illustrate: A two-boiler plant having \$750 insurance on each boiler, and \$2,500 on machinery and buildings, or \$4,000 in all, would at a pressure of eighty pounds have been written for a premium of 1 per cent., or \$40 yearly. For certain increases in the pressure allowed, an increase would be made in the rate until $1\frac{1}{2}$ per cent. was reached, producing a premium of \$60. It was not until the early eighties that consideration of the pressure allowed ceased to be an important factor in determining the premium rate.

However logical such a percentage plan may have been when a specific amount of insurance was applicable to each boiler, the very unsatisfactory character of such a basis under the altered conditions of blanket coverage was long recognized. This plan of rate-making nevertheless held for many years, and it was not until the introduction of the Manual of Rates in 1913 that this percentage method was entirely discontinued. In the meantime, the percentages had dropped to an average of less than one per cent., and in some instances to less than one-half of one per cent.

INSPECTION SERVICE.

The major portion of the premiums received by a boiler insurance company should be expended for expert mechanical services—in other words, for the care and inspection of the boilers covered under its policies. While this expenditure is of necessity heavy, it is justified by resulting benefits. Naturally these benefits accrue largely to the assured in the preservation and safe operation of his boilers and entire steam plant. Experience has also shown that the scientific examination and inspection of insured boilers produces a declining loss ratio. Conversely, any effort at a material saving in the inspection cost is fraught with danger of a large proportional increase in the loss ratio, to say nothing of the moral and social responsibility involved.

The following table taken from the *Locomotive* makes it clear that some very disastrous explosions have probably been prevented by the discovery and correction of dangerous defects:

Classification of Defects Discovered During the Year 1915.	Total Number of Defects Discovered.	Total Number of Dangerous Defects Discovered
Cases of sediment or loose scale	26,808	1,963
Cases of adhering scale	42,673	1,557
Cases of grooving	2,718	302
Cases of internal corrosion	17,843	867
Cases of external corrosion	10,872	932
Cases of defective bracing	973	246
Cases of defective staybolting	1,923	423
Settings defective	9,029	858
Fractured plates and heads	3,371	535
Burned plates	5,310	457
Laminated plates	354	40
Cases of defective riveting	1,516	274
Cases of leakage around tubes	10,670	1,475
Cases of defective tubes or flues	15,156	6,683
Cases of leakage at seams	5,060	420
Water gages defective	4,203	733
Blow-offs defective	5,185	1,616
Cases of low water	412	118
Safety-valves overloaded	1,489	453
Safety-valves defective	1,661	403
Pressure gages defective	7,958	1,050
Boilers without pressure gages	40	40
Miscellaneous defects	3,768	632
Totals for the year 1915	178,992	22,077
Totals for the year 1914	190,882	23,012
Totals for the year 1913	179,747	21,339
Totals for the year 1912	164,924	18,932
Totals for the year 1911	164,713	17,410
Totals for the year 1910	169,202	16,746
Totals for the year 1909	169,356	16,385
Totals for the year 1908	151,359	15,878
Totals for the year 1907	159,283	17,345
Totals for the year 1906	157,462	15,116
Total defects discovered during past decade ...	1,685,920	184,240

Of all boiler defects discovered during the past ten years, somewhat more than 10 per cent. were found to be of a dangerous character.

It is more to the advantage of a manufacturer to have an explosion prevented than to be reimbursed for a financial loss due to such a disaster. The assured thus receives dual protection under a

boiler policy: First, protection from preventable boiler accidents that would have caused more or less expensive losses; and second, protection from financial losses resulting from unprevented accidents.

This dual protection gives rise to the two principal elements of the premium rate: The element of inspection cost with its correlated features, and the element of the indemnity cost or the loss ratio. These two elements comprise what may be termed the net rate. To obtain the gross premium this net rate must necessarily receive a proper loading as in other lines of insurance. Such a loading would consist of the commission, the agency, and the general administration expenses.

I have purposely emphasized the dual protection secured under a steam boiler policy, as the distinctive features of steam boiler underwriting are attributable thereto.

SALARIES AND EXPENSES OF EXPERT MECHANICS.

An analysis shows that the cost of expert mechanical and inspection services comprises the largest single expense item. While the salaries of inspectors can be graded with reasonable uniformity, the travelling expenses will vary greatly with the territory covered. Indeed, when the results accomplished by inspectors travelling in the south and west are compared with the results accomplished in the same time in the thickly populated sections of the north, it is seen that even though the salaries be uniform the salary per boiler unit will vary. As the amount expended for expert mechanical services constitutes almost all of the inspection expenses, which in turn are about one-half of the entire premium income, equity requires that allowance be made in the premium rates for its unequal geographical distribution.

QUANTITATIVE BOILER INSTALLATION.

Another distinctive feature of this class of underwriting militating against the use of a uniform per boiler rate as a basis for determining premiums—a practice that in principle was at one time somewhat prevalent, and which was clearly erroneous—is the fact that in some localities there are large boiler installations, while in others there are only small and scattered units. More time being consumed, the cost per boiler is greater for inspections at plants

having the smaller installations. There are also additional expenses because of inspection visits to many plants instead of only one. These facts seem self-evident without further comment.

RELATIVE HAZARDS IN DIFFERENT KINDS OF BUSINESS.

We will now consider the relative boiler hazards in special kinds of business, and also the differing hazards and cost of inspection for certain types and makes of boilers.

The loss ratio for boilers of street railway and power companies has been found to be above the average. By the term "loss ratio," reference is made to the financial losses resulting from explosions, and not simply to the number of same. The relative *number* of explosions—accident ratio—among saw-mill boilers and kindred woodworking establishments is considerably greater than among boilers of street railway and power companies, and this is at least in part due to the relatively poor care and management they receive. The frequent and often great fluctuations in the load required in power plants of street railway companies is thought to be an important factor in the hazard element for boilers of these companies. The loss ratio for boilers in iron and steel works has also been found to considerably exceed the average. The average loss ratio for power boilers is much greater than for boilers used for heating purposes only; although there is a differing hazard for specific kinds of usage to which even heating boilers are put.

RELATIVE HAZARDS AND INSPECTION COST FOR DIFFERENT TYPES OF BOILERS.

That there is a difference in the element of hazard, and also in the cost of inspection, for different types of boilers is also a recognized fact. There are now in general use in this country two distinct types of boilers, viz.: The so-called "Water Tube" and "Fire Tube," with their respective variations of design. Time and its mechanical character forbid a discussion of the subject of the relative loss ratios for these two leading types of boilers. It may, however, be stated almost as a truism that at least the horse power per boiler unit, and also the cost of inspection per boiler unit, is greater among water tube boilers.

Statistics clearly prove that the accident and loss ratios for boilers of railroad locomotives have been excessively heavy. Frequently

these explosions have completely wrecked the locomotive. They have also caused many casualties. Damage, including that to tracks, cars and their contents, and to adjacent buildings, has amounted to hundreds of thousands of dollars. Many have been locomotives on the principal trunk lines of the country; and although the majority were pulling freight, some have been locomotives of passenger and express trains. These boilers are mostly uninsured. A few years ago the Interstate Commerce Commission promulgated its rulings to the effect that designing, construction, and inspection of these boilers must be subject to its approval. Statistics of the past year or two seem to indicate a favorable result of this ruling, as there is a noticeable decrease in the number of such explosions.

While considering types of boilers, reference should be made to the different types and kinds of vessels that carry steam, although they do not serve to generate it. Such for instance are rotaries, digesters, tanks, vulcanizers, and other insurable steam vessels. Some of these can be grouped and treated as forming a distinct class. Others must be treated as separate units. The premium must be computed independently for the group or for the unit, and must be based upon the peculiarities of the risk both with respect to the cost of inspecting and the relative hazard involved.

This theme of the types and kinds of boilers and steam vessels might well occupy an entire paper. There is time for no more than a mere intimation of its scope.

NORMAL LOSS HAZARD.

Observation seems clearly to indicate that the relative number of casualties in the United States from various causes is greater than in England. Such statistics as are available show that the boiler casualties are also greater. It is quite generally accepted that one of the underlying causes for this difference is to be found in a national characteristic: The desire to achieve the greatest results in the shortest space of time possible. This national spirit of "hustle" must of necessity enter into all the processes of construction, installation, and operation of boilers, and therefore have a cumulative effect tending to result ultimately in accidents and explosions.

Another reason for the difference in the relative number of casualties in the two countries disclosed by both observation and statistics for the past few decades, can be traced to the fact that this period has been one of unparalleled expansion, change, and growth

in the American industrial world; while on the other hand, in England the laws and the general conditions of labor have been much more stable.

Through the efforts of liability companies, the enactment of compensation laws and the growing philanthropic spirit on the part of employers, industrial conditions are rapidly changing for the better in this country. Therefore it requires no prophet to discern that comparative statistics for the next few decades, or even for the next decade, will tell a different story. As studied efforts to safeguard the worker become universal in America, and the worker becomes accustomed to exercising greater care himself, there should come about a natural tendency on the part of both employer and employee to be prudent and cautious. Such a tendency would become apparent in all lines of business, developing into a national habit. The result of this changing process should be a reduction in the number of casualties of all kinds. The specific result upon the normal loss hazard in steam boiler underwriting cannot be other than favorable.

THE CATASTROPHE HAZARD.

There yet remains to be considered the catastrophe hazard. In a sense this hazard is not peculiar to steam boiler underwriting. It does, however, differ in both degree and kind. It differs in degree in that it is not as great as in some other lines, as, for instance, in accident and fire insurance. Although it is incomparably less than in fire insurance, it is essential to note that the aggregate annual premiums are also incomparably less.

Any consideration of the catastrophe hazard brings before us the subject of the varying insurance limits per boiler unit—that is to say, the amount of insurance at stake on each boiler or battery of boilers. Until within a few years a limit of about \$5,000 was considered the proper average amount of insurance per boiler unit. As the financial resources of the boiler companies increased, attention was given to the fact that the catastrophe hazard was in no measure even approached by such a small limit.

The modern practice of installing large boiler units to reduce operating cost has become an important feature. Where formerly two boilers of 200 horse power or even three of 125 horse power were considered essential, now one large boiler of from 400 to 500 horse power may be installed. Indeed, instances are not wanting of over 2,000 horse power for a single unit. A premium based

upon \$5,000 of insurance per boiler unit would, in a three-boiler battery, when replaced by one 400 or 500 horse power boiler, be reduced proportionately; thus yielding a cash premium only $33\frac{1}{3}$ per cent. as great as for the three-boiler unit, and with a probably increased hazard. The inequity of this situation is obvious.

Statistics and experience have also shown that accidents have occurred entailing a property loss to the assured over and above his policy coverage because of his carrying insufficient insurance. The passage of liability and compensation laws by the several states already alluded to has added to the possibility of heavy compensation and liability claims in the event of an explosion causing loss of life or personal injuries. These and other considerations have during recent years led to a much larger coverage per boiler unit. A total coverage under one policy of several hundred thousand dollars is not now considered unusual. This tendency is undoubtedly wise, and decidedly in the interest of the assured. It has also given rise increasingly to the reinsurance of surplus lines, and has brought to the forefront the necessity for equitable rates for such reinsurance.

In considering the catastrophe hazard, it may be of interest to recall some catastrophes. One such occurred at Milwaukee, Wis., in 1909, when three boilers exploded, entailing a loss of approximately \$125,000. It was only four years prior to that that one of the worst calamities in the history of boiler underwriting occurred at Brockton, Mass. As a result of the explosion and ensuing fire 175 persons were injured, of whom 58 died. The estimated property loss was about \$250,000. Two years prior to that there occurred a disastrous explosion at the plant of a traction company in St. Louis, when seven water tube boilers exploded simultaneously. Nine years earlier, in 1894, there occurred a remarkable calamity at Shamokin, Pa., when thirty-six boilers exploded at the same time.

Should a calamity occur under a modern blanket policy with its very large insurance coverage applicable to a single accident, the loss ratio might easily exceed all previous experience.

A boiler plant is latent with possibilities of a calamity. The direction of the explosion and the human lives in the path of the ruptured boiler may mean more in the measure of the calamity than the value of the property on which the boiler is located. Ex-

ploded boilers have travelled half a mile and more, and several hundred feet is no unusual occurrence.

From the very nature of things it is impossible to gauge either the time or financial results of the catastrophe hazard. As well might one presume to gauge the recurrence and probable results of an earthquake by the times and results of similar disasters in the past. Surely the wisest course is to provide the best possible inspection service as a safeguard against it.

A PREMIUM FORMULA.

Possibly the most satisfactory method thus far devised for calculating basic premiums for this class of underwriting may be expressed algebraically as follows:

$$\{N(25) + L\} + \{2M + N(.10M)\} = G/P.$$

L = District apportionment.

M = An indemnity, or loss unit of \$1,000.

N = A per boiler unit.

G/P = Gross premium.

The 25 is used to represent a minimum per unit charge for inspection service, and a somewhat arbitrary but just loading for commission, agency and general administration expenses, therefore, $\{N(25) + L\}$ determines that portion of the premium essential for the inspection service and the expense loading, after making provision, by the introduction of the symbol " L ," for the unequal geographical distribution of the inspection expense heretofore noted.

The $2M$ represents a fixed charge of \$2 per each thousand of insurance, irrespective of the number of boilers involved; as increasing the number of boilers covered really increases the hazard to some extent the next symbol, namely $N(.10M)$ is introduced. Although this is a level charge of 10 cents per each thousand of insurance, it is believed to be equitable in that it varies with the per unit hazard, and it in part makes provision for that very illusive thing called the "catastrophe hazard" also. In its entirety, namely $\{2M + N(.10M)\}$ this part of the formula provides for indemnity, that is to say for losses solely.

Quantitative boiler installation may be considered as automatically adjusted by the application of the formula to the special conditions

of each plant. Expressed in its simplest form the formula would read as follows:

$$2M + N(10 + 25) + L = G/P.$$

Notable indeed has been the change and progress from the old pioneer method of determining yearly premiums on the basis of a percentage of the limited amount of insurance at that time allowed. There is reason to expect that with the increase of valuable data and the enlargement of the field of experience, rates and practices will approach more and more to that goal of scientific accuracy and justice desired by every progressive steam boiler underwriter.

ON THE RELATION OF ACCIDENT FREQUENCY TO
BUSINESS ACTIVITY.

BY

A. H. MOWBRAY AND S. B. BLACK

D. S. BEYER* COOPERATING

All mankind when in a hurry tend to cut corners and take a chance. The man hurrying for a train dodges the taxis around the station. The business man under pressure of orders hires the man he would not consider in normal times. On the other hand, when we have plenty of time we wait for the signal of the traffic officer. And when times slacken up and employers have to reduce forces the poorer workmen go first. We are all familiar with these facts. But do we give them full consideration and recognize their bearing on our own problem of compensation rate-making? Our attention has recently been forcibly called to them and their bearing on our work in connection with the returns under Massachusetts Schedule Z 1915. We believe the results of our studies thereby suggested are of sufficient importance to justify giving general publicity to them.

In the office of the Massachusetts Employees Insurance Association it has been the custom to periodically recheck after the manner of Schedule W, its loss reserves and in this connection the cost per accident reported has been worked out and followed with considerable interest. It was noted that a comparison on its experience to December 31, 1915, showed that the cost per accident reported, covered under present benefits, was almost precisely one and one-half times the cost per accident under the old scale.

When their Schedule Z figures were made up, however, it was found that the relation between the pure premiums on Part I Old Benefits and Part II New Benefits was only as 1 to 1.377. This was so inconsistent with the other figures that an investigation was at once undertaken to ascertain the reason for the apparent dis-

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crepancy. When an apparently logical explanation was found the result was communicated to the American Mutual Liability Insurance Company, whose Schedule Z showed an almost identical result, and they immediately undertook a similar investigation—with similar results.

Schedule Z shows the pay roll coverage and losses of the two periods under new and old scale benefits, so that if the number of accidents corresponding are also found we may compare for the two sets of pay rolls covered the rate of accident per unit of exposure and the cost per accident reported, as well as the pure premiums. This was done by both these companies. It was not found practicable in the first instance to consider only compensatable or only tabulatable accidents, though such an investigation may be undertaken later. Care was, however, taken to see that the accident reporting was reasonably uniform as regards detail throughout. We feel sure the results shown are not in any way due to differences in that regard.

TABLE I.

The combined figures for the two companies are:

	Audited Pay Rolls.	Accidents Re- ported.	Losses Incurred.
Part I, Original Benefits	\$344,332,391	55,511	\$1,097,489
Part II, Present Benefits	104,416,770	14,628	483,141

	No. of Acci- dents per \$100,000 of Pay Roll.	Cost per Acci- dent.	Pure Premium per \$100 of Pay Roll.
Part I Original Benefits	16.1	\$19.77	\$0.319
Part II Present Benefits	14.0	33.03	.463
Ratio Part II to Part I	87%	167%	145%

It will be noted that it was stated earlier in this paper that the schedule pure premium ratio was about 138 per cent. for each company. The combined figures above show 145 per cent., and this is due to the fact that while the pay roll exposure in Part I of the two companies was about equal, the exposure reported under Part II by the Association was nearly double that reported by the American Mutual. A comparison of figures for earlier years as presented in the successive Schedules Z and published in the reports of the Massachusetts Insurance Department shows that the aver-

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age business of the Association calls for a higher pure premium than that of the American Mutual. The same is true in the figures in both parts of Table I. Therefore, the composition of business in Part II above is not the same as in Part I. In order to bring it to about the same composition the pay roll exposure, accidents reported and losses incurred of the American Mutual were multiplied by a factor so as to give its business the same relative weight as the Association's in Part II as in Part I.

TABLE II.

	Audited Pay Rolls.	Accidents Reported.	Losses Incurred.
Part I Original Benefits	\$344,332,391	55,511	\$1,097,489
Part II Present Benefits	138,740,116	19,500	610,495

	No. of Accidents per \$100,000 of Pay Roll.	Cost per Accident.	Pure Premium per \$100 of Pay Roll.
Part I Original Benefits	16.1	\$19.77	\$0.319
Part II Present Benefits	14.05	31.31	.44
Ratio Part II to Part I	87%	158%	138%

We believe these figures more correctly set forth conditions than those in Table I.

In computing differentials to measure differences in law costs, comparison is made of the cost per case or per 100,000 standard cases under each law. The above table indicates the difference in cost as more than 1.50, but for reasons noted below we do not believe this is entirely due to changes in legal conditions. The key to the interpretation of these figures is to be found in a consideration of the periods represented by the two parts and a study of the differences in economic as well as legal conditions which distinguish them.

When the Massachusetts Compensation Act went into effect on July 1, 1912, the United States was experiencing a period of nearly normal prosperity and this continued through the year 1913 and well into the year 1914. In August, 1914, the present war in Europe broke out. American industry was temporarily staggered. For the time being our export trade was demoralized. This of itself would tend to slow down manufactures, but further, the South being unable to dispose of its cotton crop was not able

to buy manufactured products, and diminished possibilities of home consumption were to be reckoned with, as well as the diminished consumption of our products abroad. This problem was a most difficult one to meet and many mills were shut down completely. Others were run on short time and with reduced force. Unemployment during the winter of 1914 and 1915 was unprecedented throughout the country, and the revival of American business did not begin until well into 1915.

It was under such conditions that the change in the benefits in Massachusetts became effective on October 1, 1914. The experience contained in Schedule Z and in the above table relates to policies issued during the year 1914. If it be assumed that the policies issued in 1914 were evenly distributed over the year, then on the average they would expire about July 1, 1915, or just about the time American business began to revive. So far as there may have been concentration toward the earlier part of the year in the issuing of policies, and we are inclined to believe there is a slight tendency in that direction, the average expirations would occur sometime prior to the first of July, 1915. At any rate, taken on the average, the experience reported under Part II of Schedule Z for all companies, and under Part II of the above table is experience of about nine months or less, beginning during a time of extreme depression and generally terminating before the revival of business activity. It would seem to be a reasonable conclusion from this reasoning, that in part at least, the reduction in industrial activity was responsible for the reduction in accident frequency shown in this table. When men are working only part time and under no particular stress, there is reason to believe that fewer chances will be taken. Further, when operating staffs are reduced by dismissal it is usually the least competent and most reckless workers who are dropped. On the other hand, it was known that there has been a considerable amount of accident prevention work done in Massachusetts in recent years, and it was thought that possibly this might be the most important force in the reduction of accident frequency, although it was pointed out that the experience of Germany at least, with extensive accident prevention work, indicated that this work was not so effective in reducing the total number of accidents as in diminishing the seriousness of accidents.

Realizing the change in industrial conditions which took place

during the summer and fall of 1915, it seemed to us that we would be able to determine which was the more effective of these two forces in bringing about this reduction in accident frequency, if we were able to measure in some way the accident frequency per unit of exposure under these later conditions. From the Massachusetts Industrial Accident Board reports and other sources of information, as well as discussion of our own experience, we knew the number of accidents had shown a remarkable increase, but pending pay roll audits it was at first not apparent how we could determine the rate per unit of exposure. We found, however, that each company had a considerable volume of business expiring during the earlier months of 1916 upon which the pay rolls had been audited. Although we could not, without a large amount of labor, determine the cost per accident on this business, we were able very quickly to find the number of accidents reported, care being exercised to see that there was no change in the reporting of accidents as compared with the previous period. The results of this investigation are as follows, the figures, as before, being those for the companies combined:

Audited Pay Rolls.	Accidents Reported.	Accidents per \$100,000 of Pay Roll.
\$74,285,300	11,378	15.3

The volume of exposure in the above tabulation was about equal from the two companies and is fairly uniform in character to that in Table II. It seems to us sufficient to be considered reasonably conclusive, and it will be noted that the accident rate has risen over that indicated for Part II in the above table, but has not yet reached the rate in Part I.

In considering this result it should be borne in mind that these policies all expired very early in the year 1916, no policy being considered which expired as late as April 1 and most of them being January and February expirations. These policies, then, were in effect during a part of the depression period prior to mid-summer 1915, and during the earlier part of the revival period beginning at that time. We were not able to ascertain just how the exposure was distributed as between the two periods. Under the circumstances it would seem reasonable to conclude that the low accident frequency shown for Part II was largely the effect of the industrial depression existing during the time this experience was accumulated and that with reviving business conditions the accident rate

has increased. Whether or not it reaches the rate shown for Part I, it will probably exceed that indicated on the 1915 issues examined and reported above.

We attribute the increase in cost per case over 1.50 to the difficulty of getting men back to work in slack times. Our claim departments have from time to time voiced some complaint in this regard. We hope we may be able to present to the Society at some later time a careful study of this phase of the problem. Obviously it cannot be undertaken until we have a considerable volume of claims to examine which have arisen during prosperous times and have been compensated on the same scale of benefits as obtained during the slack times. We could not look into this question in connection with more recent policies, as we did with regard to accident frequency, as we did not have available the same carefully prepared reserve estimates we had on the earlier issues reported on in Schedule Z. In the meantime we did not feel that we should withhold from presentation the facts we have discovered as to the variation in accident frequency with business conditions.

Although we felt reasonably well satisfied that these results were not peculiarly characteristic of Massachusetts, and particularly of the business of our own companies, we felt the investigation would be incomplete if we did not endeavor, at least, to determine whether this phenomenon had been observed elsewhere under similar conditions. We find in Bulletin No. 92, of the United States Bureau of Labor (pages 16-17), in a discussion of the German experience from 1897 to 1907, "in a time of industrial activity new and even inexperienced employees are taken on, and all employees are urged to turn out a maximum product in order to make the fullest possible use of the machinery, and naturally a higher accident rate results." We have also communicated with Dr. Lucian W. Chaney, Special Agent of the Bureau of Labor Statistics, whose record need not be quoted before this Society, receiving the following reply:

"I am not inclined to think that given a force of a thousand men working part time, or in other ways adjusting themselves to a slack period, will, when normal conditions return have any notable rise in accident rates. If, however, a change occurs leading to the laying off of men there is always a considerable selective discharging. The least desirable men go and the accident rate goes down. When the reverse condition comes and the force is being built up a rise in rates has always occurred wherever I have been able to put the figures together."

Mr. Chaney backs this up by reference to the rise of 1909 after the depression of 1908, shown on page 118 of his "Report on Conditions of Employment in the Iron and Steel Industries of the United States," issued by the United States Bureau of Labor in 1913, the fourth volume being the one which dealt with "Accidents and Accident Prevention."

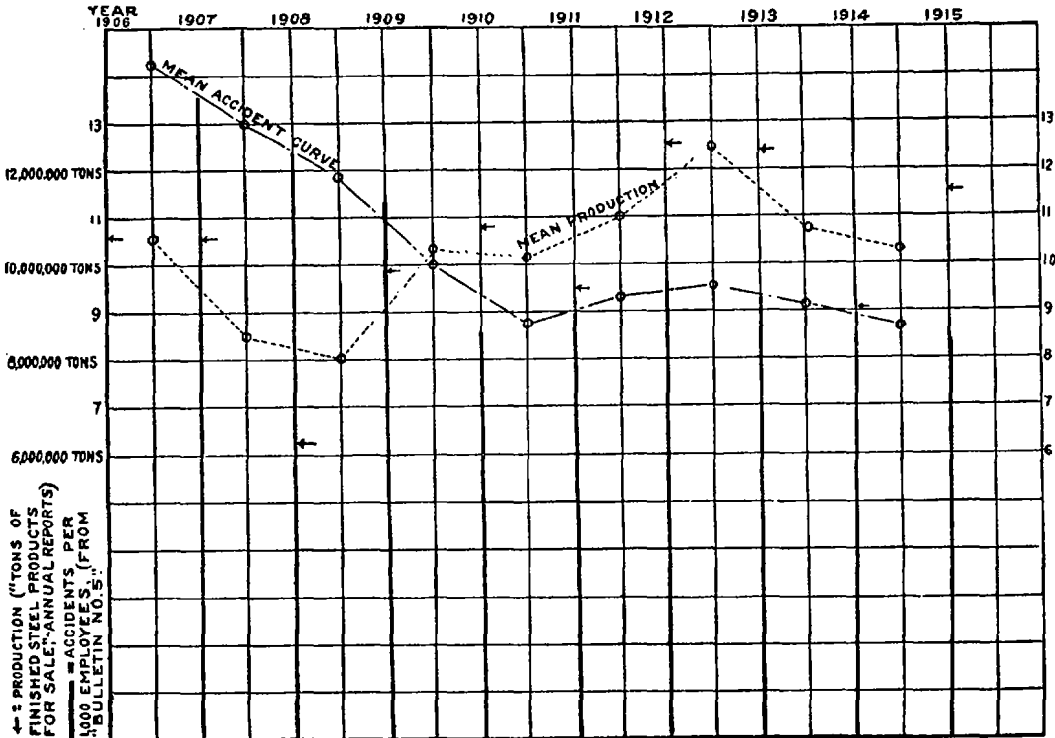


CHART SHOWING EFFECT OF PRODUCTION ON ACCIDENT FREQUENCY. (FROM U.S. STEEL CORPORATION DATA.)

Mr. Beyer further prepared from the published figures of the United States Steel Corporation as to tonnage and frequency of accident per 1,000 full time workers for the period from 1906 to 1915, the accompanying chart. This chart is exceedingly interesting. It will be noted that the period immediately following the introduction of their accident prevention movement was a period of falling production and depression. It will also be noted that, during this period the mean accident curve is sharply fall-

ing off, and when one realizes the extensiveness with which this corporation has carried on its accident prevention work, it is perhaps no occasion for surprise to find that notwithstanding the rising production between 1908 and 1909, the accident frequency rate is still decreasing. When, however, the figures from 1910 on are examined the chart seems to conform remarkably closely to the experience above presented. It will be noted that the maximum of the accident curve is not nearly so sharp as is that of the production curve, and it would seem this is to be expected. So extensive an accident prevention campaign as has been carried on by the Steel Corporation may well be expected to not only keep down the accident frequency per unit of exposure under all conditions, but to check the violence of fluctuation under the influence of modifying forces, such as increase or decrease in productive activity. We understand that the Steel Corporation has noted a corresponding tendency of the accident rate to increase during the early months of 1916.

We think the above investigations indicate very clearly that accident frequency per unit of exposure tends to rise and fall as production rises and falls, though not necessarily in the same ratio.

Although we have not found such clear evidence as we have for the above statement, from the fact that the ratio of cost per case as between Parts I and II exceeds the highest estimate made of the law differential as well as from the statements of our claim men, we are inclined to believe that during times of such extreme depression as existed in the fall and winter of 1914 there is a slight lengthening of the average period of disability when compared with that during normal times. The effect of this latter force, however, does not offset the former.

This matter of the relation of accident frequency to general business activity must receive careful consideration in the projecting of future rates and during the coming summer we will probably be brought squarely face to face with this problem. Revision at that time in the light of the new Massachusetts Schedule Z returns and the data for 1914 issues under the New York law seems a not unlikely proposal. The character of the Massachusetts data on the present scale of benefits has already been fully dealt with. The New York Act came into effect July 1, 1914, just before the sudden depression began, and the average policy year may be considered to terminate not far from July 1, 1915. Thus it also measures costs under a depression period.

In contrast with the slack conditions furnishing our cost data, the present times are so full of stress that at least some New England concerns are trying the experiment of bringing up negroes from Georgia in order to get sufficient help. As one manufacturer has put it, "We are now taking on those we have heretofore considered unemployable." Unless there is a decided falling off of business in the future, such are the conditions our rates must be prepared to meet.

OFFICE PRACTICE IN THE VALUATION OF COMPENSATION LOSSES.

BY

RICHARD FONDILLER.

This paper presents the methods in use in the New York State Insurance Fund in the valuation of claims arising under its policies. I believe that the methods outlined herein are applicable in some degree to the business of any company writing workmen's compensation in any state.

Every notice of accident received by the Fund is transcribed in its actuarial division upon an accident history card shown below. These cards may be filed in two ways: first, by year of policy issue; second, by calendar year of accident. Under either plan it is desirable to file the cards by employers, so that the loss experience of employers may be analyzed in addition to the loss experience by classifications. The cards of each employer are alphabetically arranged by employees. A medical record card is written as a carbon of the accident history card. The medical record card is successively used by the medical division, the safety engineering division, and the claim division.

The accident history card is practically a summary of the information required by the New York State Industrial Commission in the reporting of accidents. The following description of the card may be helpful.

The name of the employer and his business are given, the former information being essential because the cards are filed by employers. The statutory group and classification number are necessary in the work for the declaration of dividends on each of the groups. The cards are classified according to group, and an analysis of incurred losses is made of each group. The earned premiums in each of the groups is computed for the purpose of arriving at the amount which is divisible in the form of a dividend for each group.

The date of the policy is entered on the card, so that all accident notices may be charged to the proper year of policy issue. The number of the policy is filled in, together with the notation that

Award No.

File No.

$\frac{3}{8}$ W W

COMPENSATION

MEDICAL

Award Date	Duration		Wks.	Total Award	Award Date	Duration		Wks.	Total Award	Date	Page	Amount
	From	To				From	To					

ESTIMATED INCURRED LOSS

Valuation Date	Injury Classified as	Wks.	Medical	Temp. Total	Dismemberment	Death	Comp. Due	Susp. Mortality	All Other	Total

it is an A or a B policy, the former including and the latter excluding, medical aid; this item is required for the setting up of the medical loss in the valuation. The accident location comprises the complete address of the place where the accident occurred; an important element in the work of the safety engineering division is to investigate both the location and manner of occurrence of the accident. The accident date is a self-explanatory phrase, and the date returned to work is often filled in from the first report of the accident, or from subsequent reports. The days lost is the number of days that the employee was absent from work. The estimated duration is the length of time, counting from the date of injury, which the employer or physician reports that the employee may be disabled.

The name, address, sex and age of the employee are clearly necessary; the occupation at the time of injury is required to ascertain whether there was coverage and to what classification to charge the accident where the risk is written on a divided payroll. The daily wage, being the measure of the compensation rate, is used in the valuation of every compensatable case. A considerable portion of the card is reserved for a description of the cause and nature of the injury, as that is the foundation upon which the incurred loss is set up.

The physician and his address, or the hospital where treatment was received, is entered, so that the medical division is in possession of this information for further investigation. The date that the card is written is inserted, so that a record may be kept of losses reported after the valuation date. Whenever the facts are obtainable at the date of first report, regarding the dependents in fatal cases, that information is entered in the space provided. The serial number is used in the cases of certain employers where it is desired to keep a numerical record of all accidents for registry. In the space entitled "cash payments," there is only one column provided for medical, because experience shows there are generally not over four or five items on this account. Each payment of compensation may be posted, or only totals paid for periods of time of three, six, or twelve months each.

On the reverse side of the card, both the award number and the file number are entered, so that the case may be checked up with the records of any division which keeps its records only under one set of numbers. Every award, whether for compensation or med-

ical, made by the New York State Industrial Commission is entered on the card, as part of the daily work of the actuarial division. An absolutely essential part of the information for valuation purposes as to awards, is whether the action of the Commission at the time of the making of the award was to close or continue the case for further awards. The two-thirds of a week's compensation is the compensation rate under the New York Act.

Under the estimated incurred loss is placed the valuation of each notice, based upon the information posted on the card at the valuation date. The valuation date and classification of the injury are entered and the column "wks." is used to show the number of weeks elapsed on open temporary total cases, or to insert the schedule benefit of permanent partial cases. The use of the other columns is explained at length below, several illustrations being given.

The losses are classified in the manner shown in the paper of Mr. Joseph H. Woodward, entitled "Analysis of the Cost of 10,307 Accidents Arising under the New York Workmen's Compensation Law," appearing in the *Proceedings*, Vol. II, p. 196. After deducting the cash payments made, from the incurred loss, the balance remaining is called the "reserve." The incurred loss on the various classes of injuries is ascertained as follows:

I. (a) DEATH: DEPENDENTS.—The claim folder is consulted to ascertain the number of dependents, their dates of birth and relationship to the deceased employee. If no award has been made at the date of valuation by the Commission, the present value of the pensions of all persons claiming dependency is set up on the general theory that it is safest to take the most adverse condition of affairs. If an award has been made, the present value is computed not only of those dependents to whom an award has been made, but also of those known to be dependent. In some cases the information in the claim folder shows the existence of a family in this country or abroad. In that event, conservative assumptions are made as to the dependents and their ages, with due regard to the age of the deceased employee and the facts on file at the date of valuation.

If there is no definite information as to dependents, either by reason of their being abroad or because the death is recent and no claim for compensation has yet been filed, the married or single state of the deceased will determine the amount set up. Statistics based upon the experience of all classes of insurance carriers, including the Fund, have led us to adopt the following rules: (1)

If the employee was married, set up \$6,000 as the present value for each \$1,000 of annual earnings. (2) If the employee was single, set up \$2,500 as the present value for each \$1,000 of annual earnings. In the absence of information as to conjugal state, he is presumed to be married in those cases where he is aged 21 or over.

I. (b) DEATH: NO DEPENDENTS.—No assumption is ever made in any fatal case that there are no dependents, unless there is positive information to that effect filed in the claim papers, or where the Commission has officially determined that there are no dependents and ordered the case closed.

The incurred loss for fatal cases may be calculated by means of the tables given in my paper entitled "Tables for Computing the Present Value of Death Benefits arising under the New York Workmen's Compensation Law," in the *Proceedings*, Vol. II, p. 110. For the purposes of valuation the same amounts are set up in cases where the dependents are aliens. However, if the alien dependents procure commutation under Section 17 of the New York Workmen's Compensation Law, by which only one-half of the present value is payable, the incurred loss is then carried at the amount actually paid.

In all fatal cases the liability for the funeral benefit is carried at \$100 (which is the legal maximum), except that when a lesser amount is paid such amount is substituted. No amount is set up for medical, except in cases where medical services were given, in which event \$30 or the amount paid, whichever is the greater, is carried into the valuation.

I. (c) SUSPENDED MORTALITY.—This item has been created to meet the liability for deaths arising subsequent to valuation out of injuries originally classified as non-fatal. The sum of one-eighth of the reserves on all non-fatal cases is taken in the manner shown in the illustrations below. The assumption has been made that the cost of suspended mortality will be proportionate to the outstanding cases from which the suspended mortality may arise.

II. PERMANENT TOTAL DISABILITY.—Every claim folder is consulted in cases where it is suspected that permanent total disability may be the final development; the reports of physicians and investigators are carefully analyzed as to the nature and duration of the illness. In general, those injuries which may eventuate in permanent disability (in addition to dismemberments presumed by law to constitute permanent total disability) are skull injuries, spine injuries, paralysis, serious injuries affecting the whole body, and

TABLE I.

PRESENT VALUE OF \$1 PER ANNUM, PAYABLE MOMENTLY TILL DEATH.
SURVIVORSHIP ANNUITANTS' MORTALITY— $3\frac{1}{2}$ PER CENT. INTEREST.

Age.	Present Value.	Age.	Present Value.	Age.	Present Value.
0	23.760	35	19.471	70	8.253
1	23.699	36	19.255	71	7.884
2	23.636	37	19.033	72	7.519
3	23.570	38	18.804	73	7.159
4	23.502	39	18.568	74	6.805
5	23.431	40	18.325	75	6.458
6	23.357	41	18.074	76	6.118
7	23.281	42	17.817	77	5.786
8	23.201	43	17.552	78	5.462
9	23.118	44	17.280	79	5.148
10	23.033	45	17.000	80	4.843
11	22.943	46	16.714	81	4.549
12	22.851	47	16.420	82	4.265
13	22.755	48	16.119	83	3.992
14	22.655	49	15.811	84	3.730
15	22.551	50	15.497	85	3.480
16	22.444	51	15.175	86	3.241
17	22.332	52	14.847	87	3.014
18	22.217	53	14.513	88	2.799
19	22.097	54	14.172	89	2.596
20	21.972	55	13.826	90	2.404
21	21.843	56	13.475	91	2.224
22	21.709	57	13.118	92	2.055
23	21.570	58	12.756	93	1.897
24	21.427	59	12.391	94	1.750
25	21.278	60	12.022	95	1.613
26	21.123	61	11.649	96	1.487
27	20.964	62	11.274	97	1.371
28	20.798	63	10.896	98	1.263
29	20.627	64	10.518	99	1.165
30	20.450	65	10.138	100	1.076
31	20.267	66	9.758	101	.995
32	20.077	67	9.379	102	.922
33	19.882	68	9.002	103	.854
34	19.680	69	8.626	104	.790
				105	.653
				106	.500

The younger ages are included, for the sake of completeness.

serious cases where the injured employee is over sixty years of age. Very few cases are recognizable during the first six months after the date of accident as permanent total disabilities. Cases where the probability is slight that the employee will ever recover his earning power should be placed in the permanent total class.

The incurred loss is assumed to be the present value of a life annuity taken at the date of accident of the age of the injured employee, in cases where the date of valuation is less than six months after the date of the accident. The New York State Industrial Commission has adopted for purposes of valuation and commutation the Survivorship Annuitants' Table of Mortality with $3\frac{1}{2}$ per cent. interest; the values are given in Tables I and II. It is convenient to use the same mortality table for permanent total and fatal cases.

Example 1.—The injured employee is aged 40 and earned \$3 daily. He is entitled to a weekly compensation of \$11.54 for life, which amounts to \$600.08 annually. Referring to Table I, the present value of \$1 at age 40 is 18.325, which should be multiplied by \$600.08, the annual award. The product, \$10,996.47, is the incurred loss on this case, as of the date of accident. Ten years later, the present value of this case is the product of \$600.08 and 15.497 or \$9,299.44.

Some cases that are valued as permanent total may finally result in temporary total by full recovery or return to work of the injured employee, in which event an award is made to such date and the case is closed by order of the Commission. In these cases, however, it is safest to review all the claim papers before taking down the permanent total reserve. Other cases may terminate in death, in which event they should be valued as fatal cases. In this connection, it is often desirable to secure the names, ages and relationships of dependents in permanent total cases. Any case which has been outstanding as a temporary total for two years, is thereafter valued as a permanent total. In the majority of instances the value of a fatal case is less than that for permanent total disability; this is invariably true where the age of the injured employee is under 50.

III. PERMANENT PARTIAL DISABILITY—DISMEMBERMENT.—This classification falls into three divisions.

1. Those cases involving physical loss, either total or partial, by amputation of one of the members of the body.
2. Those cases in which there is a loss of use, either total or partial, of any of these members.

TABLE II.

PRESENT VALUE OF \$1 PER ANNUM, PAYABLE MOMENTLY FOR DURATIONS GIVEN. SURVIVORSHIP ANNUITANTS' MORTALITY— $3\frac{1}{2}$ PER CENT. INTEREST.

Age.	Years.					
	1	2	3	4	5	6
15	.98055	1.92295	2.82867	3.69913	4.53568	5.33964
16	.98054	1.92293	2.82862	3.69903	4.53553	5.33941
17	.98054	1.92290	2.82855	3.69892	4.53535	5.33914
18	.98053	1.92286	2.82848	3.69879	4.53514	5.33885
19	.98052	1.92283	2.82841	3.69865	4.53493	5.33854
20	.98051	1.92280	2.82832	3.69849	4.53468	5.33817
21	.98050	1.92275	2.82822	3.69831	4.53439	5.33776
22	.98049	1.92270	2.82811	3.69813	4.53410	5.33733
23	.98048	1.92265	2.82799	3.69791	4.53376	5.33683
24	.98046	1.92259	2.82786	3.69767	4.53338	5.33628
25	.98044	1.92253	2.82771	3.69741	4.53296	5.33568
26	.98043	1.92246	2.82756	3.69712	4.53251	5.33501
27	.98041	1.92237	2.82736	3.69678	4.53197	5.33423
28	.98039	1.92229	2.82716	3.69642	4.53140	5.33341
29	.98036	1.92218	2.82694	3.69601	4.53076	5.33248
30	.98033	1.92207	2.82688	3.69556	4.53005	5.33143
31	.98030	1.92196	2.82641	3.69508	4.52928	5.33031
32	.98027	1.92182	2.82610	3.69451	4.52840	5.32903
33	.98023	1.92167	2.82576	3.69389	4.52742	5.32761
34	.98019	1.92150	2.82537	3.69321	4.52634	5.32604
35	.98014	1.92131	2.82494	3.69245	4.52513	5.32429
36	.98009	1.92110	2.82448	3.69160	4.52381	5.32235
37	.98004	1.92088	2.82396	3.69068	4.52234	5.32021
38	.97997	1.92062	2.82338	3.68963	4.52068	5.31780
39	.97990	1.92033	2.82273	3.68847	4.51886	5.31515
40	.97982	1.92001	2.82201	3.68718	4.51682	5.31219
41	.97973	1.91966	2.82122	3.68575	4.51458	5.30893
42	.97964	1.91927	2.82033	3.68417	4.51208	5.30530
43	.97953	1.91885	2.81935	3.68242	4.50932	5.30128
44	.97941	1.91836	2.81826	3.68046	4.50623	5.29680
45	.97928	1.91783	2.81706	3.67830	4.50282	5.29183
46	.97913	1.91724	2.81571	3.67588	4.49901	5.28632
47	.97897	1.91658	2.81422	3.67320	4.49480	5.28020
48	.97878	1.91584	2.81254	3.67022	4.49011	5.27339
49	.97858	1.91502	2.81071	3.66693	4.48493	5.26589
50	.97835	1.91413	2.80867	3.66328	4.47919	5.25756
51	.97811	1.91313	2.80641	3.65923	4.47282	5.24832
52	.97782	1.91200	2.80387	3.65471	4.46572	5.23805
53	.97752	1.91078	2.80110	3.64974	4.45791	5.22673
54	.97719	1.90941	2.79800	3.64420	4.44922	5.21416

TABLE II (continued).

Age.	Years.					
	1	2	3	4	5	6
55	.97680	1.90789	2.79456	3.63807	4.43959	5.20024
56	.97638	1.90619	2.79073	3.63125	4.42891	5.18482
57	.97591	1.90431	2.78649	3.62370	4.41709	5.16778
58	.97539	1.90224	2.78182	3.61537	4.40406	5.14898
59	.97482	1.89993	2.77663	3.60613	4.38961	5.12818
60	.97418	1.89737	2.77087	3.59590	4.37364	5.10520
61	.97347	1.89453	2.76449	3.58459	4.35599	5.07986
62	.97268	1.89139	2.75744	3.57208	4.33651	5.05192
63	.97181	1.88791	2.74962	3.55824	4.31499	5.02113
64	.97084	1.88405	2.74098	3.54295	4.29128	4.98724
65	.96977	1.87977	2.73142	3.52609	4.26516	4.95000
66	.96857	1.87504	2.72086	3.50749	4.23641	4.90909
67	.96725	1.86980	2.70919	3.48699	4.20479	4.86423
68	.96579	1.86401	2.69632	3.46442	4.17007	4.81510
69	.96418	1.85761	2.68212	3.43959	4.13199	4.76138
70	.96238	1.85053	2.66646	3.41229	4.09026	4.70272
71	.96040	1.84271	2.64923	3.38235	4.04464	4.63884
72	.95820	1.83409	2.63027	3.34953	3.99483	4.56938
73	.95578	1.82459	2.60945	3.31362	3.94058	4.49406
74	.95310	1.81412	2.58661	3.27439	3.88157	4.41256
75	.95014	1.80259	2.56156	3.23159	3.81754	4.32462
76	.94687	1.78992	2.53416	3.18502	3.74827	4.23006
77	.94327	1.77600	2.50424	3.13445	3.67353	4.12872
78	.93930	1.76074	2.47161	3.07967	3.59312	4.02048
79	.93493	1.74403	2.43611	3.02050	3.50692	3.90539
80	.93013	1.72575	2.39756	2.95675	3.41484	3.78352

3. Cases of disfigurement of any part of the body.

1. The incurred loss in these cases is taken as the product of the weekly compensation multiplied by the number of weeks compensation specified in the statute for the particular dismemberment involved. Discount for mortality and interest is disregarded for reserve purposes. In most cases it is apparent, from the description of the cause and nature of the injury on the accident history card, that amputation has or will eventually result, and it is therefore not essential to look over the claim folder. In doubtful cases it is the practice to consult the claim record card of the claim division, to which are attached copies of reports in the claim folder, in preference to attempting to secure the claim folder, which is necessarily in much greater demand by the various divisions of the Fund. In border-line cases, where the loss may be either total or partial, the former is always assumed. The most difficult class of

cases are eye injuries. A splinter of steel in the eye—a common accident in the steel industry—more often results in loss of vision than other foreign substances in the eye. In cases where the employee has received multiple injuries in one accident, he may receive compensation for total temporary disability, in addition to an award for permanent partial disability.

2. Cases in which compensation is paid under the total temporary disability classification for a period in excess of three months, and which are described as injuries to the knee, ankle, elbow or wrist frequently are finally granted awards for the injured member under the loss of use clause, either total or partial. Disabilities of this nature that are protracted for a year or over from the date of injury will generally result in total loss of use, and it is therefore our practice in such cases to set up as the incurred loss the entire schedule benefit.

3. An award for disfigurement (not exceeding \$3,500) may be made under the amendment effective June 1, 1916, to the New York Workmen's Compensation Law.

Present Values of Dismemberments.—Table II is used for the commutation of benefits payable under the dismemberment schedule of the New York Act, where a lump sum settlement is granted.

Example 2.—In the case of an employee, aged 35, earning \$4.50 daily, who lost an arm, the compensation is payable for 312 weeks at \$17.31 weekly. The amount of the award paid annually is 52 times \$17.31, or \$900.12. This last amount should be multiplied by the annuity at age 35 for six years, 5.32429, to secure the present value, \$4,792.50.

Example 3.—Take a case where the employee, aged 50, earning \$2.50 daily, lost the use of a foot; the benefit is 205 weeks, out of which 15 weeks have been paid, and commutation is granted for the balance of 190 weeks at \$9.61 weekly. The period of 190 weeks is equal to 3.65385 years. Table III gives weeks expressed as a decimal of a year. The method of computation follows:

Age 50—Annuity at fourth year	3.66328
Age 50—Annuity at third year	2.80867
Difference .....	.85461
Multiply by fraction of year .....	.65385
Product .....	.55879
Add annuity at third year	<u>2.80867</u>

Annuity at 3.65385 years	3.36746
Multiply by annual award	<u>\$499.72</u>
Present value of 190 weeks	\$1,682.79

TABLE III.

WEEKS EXPRESSED AS A DECIMAL OF A YEAR.

Weeks.	Decimal.	Weeks.	Decimal.	Weeks.	Decimal.
1	.01923	21	.40385	41	.78846
2	.03846	22	.42308	42	.80769
3	.05769	23	.44231	43	.82692
4	.07692	24	.46154	44	.84615
5	.09615	25	.48077	45	.86538
6	.11538	26	.50000	46	.88462
7	.13462	27	.51923	47	.90385
8	.15385	28	.53846	48	.92308
9	.17308	29	.55769	49	.94231
10	.19231	30	.57692	50	.96154
11	.21154	31	.59615	51	.98077
12	.23077	32	.61538	52	1.00000
13	.25000	33	.63462		
14	.26923	34	.65385		
15	.28846	35	.67308		
16	.30769	36	.69231		
17	.32692	37	.71154		
18	.34615	38	.73077		
19	.36538	39	.75000		
20	.38462	40	.76923		

IV. PERMANENT PARTIAL DISABILITY—NOT DISMEMBERMENT.

—These are cases resulting in decreased earnings, where the award is made for two-thirds of the reduction in earning power. Those cases that are open on the date of valuation have the incurred loss set up according to Table C in Mr. Woodward's paper.

Example 4.—An employee, aged 47, who was injured on September 3, 1915, earned on the date of injury \$24 weekly and subsequently earned only \$15 weekly. He is entitled to two-thirds of the difference, or \$6 weekly, so long as his disability continues. Assume that he has been awarded \$6 weekly until the valuation date, March 31, 1916, at which time his case has been marked "continued," and it is consequently an open case. On March 31, 1916, 30 weeks have elapsed since the date of injury, and Table C gives a reserve of \$220 for each dollar of compensation at 30 weeks. The product of 6 and \$220 gives \$1,320 as the reserve on this case.

Example 5.—If in Example 4, the Commission closed the case by awarding the employee the sum of \$6 weekly for life, then the reserve is computed by multiplying the annual award of \$312 by 16.420, the value in Table I at age 47, which amounts to \$5,123.04.

V. (a) TEMPORARY TOTAL DISABILITY—OPEN CASES.—Cases in which the injured employee has not recovered or returned to work, or upon which information as to these facts is not ascertainable at the date of valuation, are called “open.” Whether an award has been made or not, the incurred loss consists of the total of the following items:

1. The reserve set up according to Table C (*Proceedings*, Vol. II, p. 200).

2. The compensation due prior to the date of valuation, which is the product of the compensation rate and the number of weeks (less the two weeks’ waiting period) elapsed since the date of accident.

3. One-eighth of the reserve under Item 1 for suspended mortality.

4. Medical, \$30 on each case, or the amount of medical actually awarded, whichever is the greater.

The most serious of the temporary disabilities result in death or permanent total disability, and in either event the amount as computed by Table C sets up an increasing incurred loss on the theory that the longer a man has been disabled the more nearly he approaches permanent total disability. A large percentage of cases of arm and leg injuries on which compensation is awarded under the temporary total disability provision are continued as such for many months, until amputation or loss of use of the member results, upon which the Commission grants the balance of the schedule benefit for dismemberment, and thus it retroactively becomes a case of permanent partial disability. In this last class of cases, if it has been reserved for as a temporary total disability case at the time when the award for dismemberment is made, the incurred loss thus set up is generally equal to or greater than the permanent partial award that is finally granted.

V. (b) TEMPORARY TOTAL DISABILITY—CLOSED CASES.—These are by far the most numerous class of cases, constituting about five-sixths of all compensatable cases in the experience. By a “closed” case is meant one where the injured employee has recovered or returned to work, according to the records, at the date of the valua-

tion. There are many cases in which the injury occurred six or more months prior to the valuation date and which have not been officially adjudicated by the Commission, owing to the delay of the employer or employee in filing the necessary papers, but which are deemed closed under the above definition. In cases where the date of recovery is reported, but no claim for compensation had been filed at the valuation date, the amount set up is the liability for compensation to date of recovery. In the absence of information as to the date of recovery, it is presumed that the employee has not recovered and it is valued as an open case.

VI. TEMPORARY PARTIAL DISABILITY.—Cases in which this kind of benefit is payable directly after the two weeks' waiting period are rare. The majority of these cases have previously received awards of temporary total disability, and when the injured employee has returned to work at a reduced wage, an award for two-thirds of his reduction in earning power is granted, which is terminated upon evidence of his recovery or return to work at his former earning power. This class of cases has generally been awarded some other kind of benefit, in addition to that of temporary partial disability. When the case is closed, it is placed in that class of benefit in which the largest amount of compensation was paid, and it appears in the statistics as only one case.

VII. (a) MEDICAL AID—COMPENSATABLE CASES.—On accidents reported under policies providing for medical aid, where the injury is classified as being in one of the previous divisions of compensatable cases, the sum of \$30 is set up as the average incurred loss for medical. This average covers awards under the medical provision of the law, using the word "medical" in its broadest sense to include physicians' services, hospital bills for board and lodging, nurses' fees, surgical operations, artificial surgical appliances and medicines. Where medical actually paid at the valuation date exceeds \$30, the amount paid is carried into the incurred loss.

VII. (b) MEDICAL AID—NON-COMPENSATABLE CASES.—Where the notice of injury or subsequent employer's report gives the date of recovery or return to work as being within the two weeks' waiting period, the case is clearly not compensatable. Where a policy provides for medical aid, the sum of \$10 is set up as the incurred loss, or the amount actually paid, whichever may be the greater.

VIII. No Loss.—There are two classes of cases under this head: first, policies providing for medical aid in accidents that are not

compensatable and which are so trivial as not to require any medical service or first-aid treatment; second, policies not covering medical, where the cost of medical aid is borne by the employer, and hence is a no-loss case so far as the insurance carrier is concerned.

Revaluations.—A valuation of every case is made quarterly, because a financial statement of the Fund is made as of March 31, June 30, September 30, and December 31 of every year. Open cases are revalued at every valuation, the incurred loss being taken as the sum of the cash payments and the outstanding liability at the valuation date.

ILLUSTRATIONS OF VALUATIONS ON ACCIDENT HISTORY CARDS.

ILLUSTRATION 1.

ESTIMATED INCURRED LOSS.

Valuation Date.	Injury Classified as	Wks.	Medical.	Temp. Total.	Dis- mem- berment.	Death.	Comp. Due.	Susp. Mortality.	Funeral.	Total.
6-30-15	Open T.T.	7	B	144	...	.....	48	18	.....	210
9-30-15	" "	20	...	1,153	...	.....	173	144	.....	1,470
12-31-15	Dead	...	...	.....	.....	4,500	.....	.....	100	4,600
3-31-16	" "	...	...	.....	.....	4,069	.....	.....	100	4,169

In Illustration 1, the employee was injured on May 12, 1915, and died on October 15, 1915. Daily wage \$2.50, weekly compensation rate \$9.61. The notice of accident stated that he was struck by a rock from a blasting machine and that he was seriously injured in the back. On June 30, 1915, it was valued as an open temporary total case, on account of the seriousness of the injury, although no award had yet been made. Up to September 30, 1915, several awards of compensation had been made and the case continued, hence it was still carried as an open case. The dependents were unknown on December 31, 1915, and the case was valued at \$6,000 per \$1,000 wage because the deceased was married. By March 31, 1916, the dependents were found to be a widow, aged 50, and children aged 16 and 10; the present values were set up for these annuitants. No amount was set up for medical, as this loss occurred under a B policy, under which the employer assumes the cost of statutory medical aid.

ILLUSTRATION 2.
ESTIMATED INCURRED LOSS.

Valuation Date.	Injury Classified as	Wks.	Medical.	Temp. Total.	Disen-berment.	Death.	Comp. Due.	Susp. Morality.	Perm. Total.	Total.
12-31-14	Open T.T.	8	105	190	.....	...	60	24	.....	379
3-31-15	" "	21	150	1,300	.....	...	190	162	.....	1,802
6-30-15	" "	34	165	2,600	.....	...	320	325	.....	3,410
9-30-15	Perm. Part.	288	165	.....	2,880	.....	.....	301	.....	3,346
12-31-15	Perm. Total— Age 67.....	.....	180	.....	.....	.....	.....	610	4,877	5,667

In Illustration 2, the employee, aged 66, was injured on November 6, 1914. Daily wage \$2.60, weekly compensation rate \$10. He fractured his left leg when a horse suddenly started his wagon and threw him to the pavement while attempting to get on the wagon. A number of awards of total temporary disability were made to him, and the case was reserved for on the basis of Table C for three valuations. Indications pointed to an ultimate award for loss of use of leg, 288 weeks, and the injury was therefore classified as a permanent partial on September 30, 1915. Medical examinations subsequently disclosed the fact that the hip was seriously affected, and on account of the advanced age of the employee, recovery was a remote probability. Since December 31, 1915, this case has been valued as a permanent total.

ILLUSTRATION 3.
ESTIMATED INCURRED LOSS.

Valuation Date.	Injury Classified as	Wks.	Medical.	Temp. Total.	Disen-berment.	Death.	Comp. Due.	Susp. Morality.	All Other.	Total.
3-31-15	Open T.T.	12	195	315	.....	...	75	39	.....	624
6-30-15	" "	25	235	1,275	.....	...	172	159	.....	1,841
9-30-15	" "	38	290	2,250	.....	...	270	281	.....	3,091
12-31-15	Perm. Part.	312	290	.....	2,340	.....	.....	245	.....	2,875
3-31-16	" "	244	305	.....	1,830	.....	.....	169	.....	2,304

In Illustration 3, the employee was injured on January 8, 1915. Daily wage \$1.95, weekly compensation rate \$7.50. He received a compound fracture in the right arm in an accident while working at a machine. In the three valuations following the date of injury,

it was reserved for as an open temporary total case. The claim folder showing that an award for loss of use of the arm would probably be made, it was set up as a permanent partial for that benefit on the December 31, 1915, valuation. In January, 1916, the employee having received 54 weeks' compensation under the guise of total temporary disability, was granted an award of 190 weeks, which was the balance for loss of use of hand.

Up to December 31, 1915, 51 weeks' compensation had accrued, leaving a balance (not as an award but according to the valuation on that date) due of 261 weeks at \$7.50 weekly, amounting to \$1958. One-eighth of this amount, or \$245, was set up for suspended mortality on the December 31, 1915, valuation. One-eighth of the amount due *after* the valuation date, is placed under suspended mortality on all permanent partial cases.

ILLUSTRATION 4.
ESTIMATED INCURRED LOSS.

Valuation Date.	Injury Classified as	Wks.	Medical.	Temp. Total.	Dismem-berment.	Death.	Comp. Due.	Susp. Mortality.	Perm. Total.	Total.
12-31-14	Open T.T.	6	B	180	...	...	60	22	.....	262
3-31-15	" "	19	...	1,650	...	...	255	206	.....	2,111
6-30-15	" "	32	...	3,600	...	...	450	450	.....	4,500
9-30-15	Perm. Total— Age 42	...	...	.....	.....	.....	.....	1,737	13,897	15,634
12-31-15	Temp. T. Closed.....	...	...	810	.....	.....	.....	.....	.....	810

In Illustration 4, the employee was injured on November 18, 1914. Daily wage \$5.20, weekly compensation rate \$15.00 (maximum). He fell off a platform and received contusions all over the body. Numerous awards for total temporary disability were granted, and it was consequently set up as an open case, according to the values in Table C, on December 31, 1914, March 31, 1915, and June 30, 1915. A reserve for permanent total disability was carried in the September 30, 1915, valuation, the claim papers all pointing to such a conclusion. However, after that date the employee made such a rapid recovery, that he had returned to work on December 16, 1915, as of which date the case was closed by the Commission on December 27, 1915. On the December 31, 1915, valuation the entire loss consisted of 54 weeks' compensation, and the injury was classified as a total temporary disability.

Unreported Losses.—This item is one requiring careful consideration, and, in a final analysis, must depend upon the geographical distribution of the policy issues of the insurance carrier. In the case of the New York State Insurance Fund, only risks within the State of New York are carried, and the Fund is therefore in fairly close touch with its policyholders and is in prompt receipt of reports of accident.

The rule adopted after numerous practical tests is as follows: All notices in which the accident date is prior to the date as of which valuation is made, are included in the valuation and all accidents occurring after such valuation date are put aside for subsequent quarterly valuations. If the valuation is completed fifteen days after the date as of which the valuation is made, 15 per cent. of the aggregate incurred loss for the six months preceding the valuation date is added for unreported losses. One-half of 1 per cent. is deducted for every day later at which the valuation is completed. For instance, if the valuation is concluded twenty-five days after the date of valuation, then only 10 per cent. of such incurred loss is added for unreported losses. The addition is then distributed back over the incurred loss for the six months in question, in the ratio that the reported loss under each kind of injury bears to the aggregate reported loss.

Lump Sum Settlements.—Section 25 of the New York Law provides that “the Commission, whenever it shall so deem advisable, may commute such periodical payments to one or more lump sum payments, provided the same shall be in the interest of justice.” Commutation is frequently resorted to in border line cases that have been classified as open temporary total or permanent total for the purposes of valuation only. Any settlement that is predicated upon the incurred loss set up by valuation standards is likely to be erroneous, for the reason that valuation standards for these classes of cases merely attempt to provide an average which may be more or less than the amount to which the insurance carrier and the injured employee jointly agree as being a fair lump sum settlement.

A long-standing case of temporary total disability may have all the earmarks of a permanent total case and yet a partial or complete recovery may ensue shortly after the valuation date. The valuation cannot even be considered to be an approximate measure of an amount that may be paid as a lump sum, and therefore each case under consideration for such a settlement must be individually

considered, medically and actuarially, before a settlement is finally agreed upon.

Subrogation.—All notices of injury are inspected upon their receipt, to ascertain cases in which the employee was injured through the negligence of a third party. In such cases the full amount of the incurred loss is set up on account of uncertainty as to whether there is a good cause of action or the possibility of recovery on a judgment against the third party. If a settlement is made with the third party, it is deducted from the incurred loss, and the balance is set up at the next quarterly valuation.

Tabulatable Accidents.—According to the accepted definition “a tabulatable accident is one which causes loss of time on any day other than the day of the injury.” Judging from the clarity of this definition, it should be simplicity itself to take any number of accident notices and divide them into the two classes of tabulatable and non-tabulatable accidents. Yet, in practice, there are a number of factors which militate against any system which requires as its foundation an accurate record of tabulatable accidents. Personal inspection of a large number of cases and reports leads me to make the following comments:

1. The employer's first report of injury has a question: “Has employee returned to work?” which often remains unanswered, either through lack of information, or the negligence of the employer.

2. The tendency of some employers is to fail to report any accidents except in those cases where the injured employee may become entitled to compensation.

3. Where the employer carries a policy under which he pays the medical cost, he is under a great temptation not to report those accidents which appear to him to be not compensatable; such a practice may be carried on indefinitely without coming to the knowledge of the insurance carrier, since the latter is not required to make any payments for compensation or medical.

4. Many injuries that are trivial at the time of reporting to the Commission and which state that the employee returned to work on the same day, ultimately develop into compensatable cases or cases where the employee may lose one or more days. There are always a number of such cases when experience data is compiled, and, in this respect, such data is both misleading and inaccurate.

5. The rules of the New York State Industrial Commission do

not require the employer or employee to file any report as to the date of recovery, except in cases where the employee claims compensation because of disability exceeding fourteen days. There are probably 150,000 non-compensatable cases reported annually in New York State, which never come to the attention of the Commission but are filed as "No Claim" in the claim division.

In order to determine the correct number of tabulatable accidents, a large amount of labor and expense is involved, and it is not likely that any insurance carrier makes any attempt to go to these lengths to secure statistical information which does not affect its financial statement.

Since there are over 15,000 notices of accident received by the Fund annually, it becomes essential to have a system which permits of a rapid summary to be made of incurred losses of any policy or calendar period. The methods outlined herein have been thoroughly tested in the business of the Fund, and have the merit of being practical, easily understood and permit of a valuation being completed within a month after the date as of which the valuation is made.

A STUDY OF WORKMEN'S COMPENSATION SCHEDULE
"W" AND THE PROBLEMS INCIDENT THERETO.

BY

EDWARD S. GOODWIN.

The enactment of workmen's compensation laws in this country imposed upon the insurance departments of a certain few but relatively important states a new function, that of approving, as to their adequacy and non-discriminatory nature, premium rates in connection with a line of business under which American experience results were not available. As such supervision required a close scrutiny of the various expense items and a determination of the amount of ultimate losses some method of accumulating actual experience was necessary. To meet this requirement a form of report known as Schedule "W" was devised for use in certain states only. In each instance it was confined to the workmen's compensation business of such state and was similar in form to pages 2, 3, 5, 8 and 9 of the annual statement.

This report has now been prepared for the states of Massachusetts and Wisconsin for four years and for New York for two years and consequently ample opportunity has been afforded for studying the results obtained with the idea of so rearranging the schedule as to increase the value of the statistics resulting from its compilation. To avoid unnecessary discussion of minor details, which may be peculiar to any one state, and to make clear the suggested arrangement a schedule in which the proposed changes are incorporated has been prepared. The intent is that the form shall meet the requirements of supervisory bodies, the public and the reporting companies. Before treating the schedule in detail a preliminary consideration of the underlying principles involved in the suggested arrangement is essential.

Because of the technical nature of the record it should set forth the required information clearly, concisely and in logical order of sequence, not only in detail but also summarized by groups of associated items. Such an arrangement will make possible an intelligent interpretation of the results without retabulating the items

and will exhibit them in a form easily comprehended. With this general idea in mind a schedule has been prepared which consists of five principal divisions, viz., "Receipts," "Disbursements," "Liabilities," "Exhibit of Previous Estimates of Unpaid Losses," and "Gain or Loss Exhibit." Within these divisions appear six groups of associated items in the following order: "Premiums," "Losses," "Service," "Taxes, Licenses and Fees," "Acquisition" and "Administration." These groups are intended to produce in the Gain or Loss Exhibit, in the form of ratios, such indications as are necessary for the purposes of those entrusted with the supervision of the business.

The intent of the Premium group is, of course, to obtain a record for purposes of comparison with the various expense groups.

The first group of expense items is Losses, which includes medical aid, and this group is by reason of its size the principal factor in the determination of premium rates. There are two principal reasons why this item requires separate treatment, one of which is that it is a fixed charge determined by law and the decisions of boards and cannot arbitrarily be reduced except at the expense of injured workmen. The other is that it is a particularly difficult item to place on a correct ultimate basis and requires careful individual treatment.

The Service group includes those expenditures which though not classed as losses are for the benefit of injured workmen and their employers and which for that reason should be sufficient for the purpose and must not be limited since to do so would be to defeat certain of the most important purposes of workmen's compensation legislation—the elimination of preventable industrial accidents and the rendering of claim service in connection with those which are unpreventable. The first two subdivisions cover the cost of accident prevention work and of making compensation payments and clearly constitute service items. The third item, which is relatively of much less importance, is payroll audit expense. It has been placed in this group in preference to others for the reason that it serves to protect honest and well-informed policyholders against understatement of payroll, intentional or otherwise, by their competitors. In the final analysis, this ultimately produces for the benefit of the first class of employers the lower average level of rates which experience must indicate when complete payroll reports are included.

The group Taxes, Licenses and Fees is self-explanatory and is

maintained as a separate item because these also are charges over which the companies have no control and which they consequently cannot be required to limit.

The next two groups, which are Acquisition and Administration respectively, are provided for in that portion of the premium charge which is applicable to expenses which the companies and supervisory bodies should limit and are limiting to the utmost extent consistent with a proper handling of the business. As the agents act in an advisory capacity to policyholders respecting matters of law and insurance coverage, the payment to them must be sufficient to attract capable men to the service and no limitation can wisely be applied which will defeat that end. The Administration charge in the case of well-managed companies is a minor item as compared with most of the other group charges and, while it should be carefully limited to what is actually necessary, will not materially affect the premium charge. With this explanation of the reasons governing the makeup of the suggested schedule, copies of all five principal divisions are submitted as a prelude to further discussion.

RECEIPTS.

Premiums:

1. Written and renewed	\$....
2. Policies not taken .....	....
3. Remainder	\$....
4. Returned on canceled policies .....	....
5. Remainder	\$....
6. Additional	\$....
7. Refunds .....	....
8. Net increase or decrease	\$....
9. Total or remainder	\$....
10. Reinsurance .....	....
11. Remainder	\$....
12. Dividends to policyholders, less assessments .....	....
13. Net premiums	\$....

DISBURSEMENTS.

Losses:

14. Death (Incl. funeral benefits \$....)	\$....
15. Permanent total
16. Dismemberment
17. Permanent partial
18. Temporary
19. Total	\$....

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20. Medical aid
21. Total	\$.....
22. Cases dependent upon negligence, including medical aid..
23. Total	\$.....
24. Deduct reinsurance received .....	.....
25. Net benefits, including medical, surgical & hospital items.....	\$....
<i>Service:</i>	
26. Safety inspection and accident prevention, including \$... specific inspection fees paid to .....	.....
Inspection Rating Board	\$....
27. Investigation and adjustment of losses, including arbitration fees and legal and other expenses of hearings and court proceedings .....	.....
28. Payroll audit .....	.....
29. Total	\$....
<i>Taxes, Licenses and Fees:</i>	
30. State tax on premiums @%	\$....
31. All other items on business of this schedule .....	.....
32. Total	\$....
<i>Acquisition:</i>	
33. Commissions	\$....
34. All other* .....	.....
35. Total	\$....
<i>Administration:</i>	
36. Paid underwriting expense not listed above†	\$....
37. Total Disbursements	\$....

LIABILITIES.

Premiums Unearned:

38. Gross premiums upon all unexpired risks \$....; unearned (pro rata)	\$....
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Losses Outstanding, present values:‡

39. Death (Incl. funeral benefits \$....)	\$....
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* There should be included in this item such amounts of acquisition expense, other than commissions, as are subject to the 17½ per cent. limitation of acquisition expense. Salaries and expenses of managers and agents and a proper provision for rents and other overhead expenses chargeable to business of this schedule must be included. Has this been done? Answer

† There should be included in this item those amounts which are chargeable to the underwriting and administration of the business of this schedule. Has this been done? Answer

‡ There should be included in this item the present value of all future payments to be made on account of injuries sustained in connection with the business of this schedule, the amount for each injury to be estimated separately. Has this been done? Answer

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40. Permanent total
41. Dismemberment
42. Permanent partial
43. Temporary
44. Total	\$.....
45. Medical aid .....	.....
46. Total	\$.....
47. Cases dependent upon negligence, including medical aid..	.....
48. Total	\$.....
49. Deduct reinsurance due .....	.....
50. Net benefits, including medical, surgical & hospital items.....	\$.....
<i>Service Outstanding:</i>	
51. Safety inspection and accident prevention, including \$... specific inspection fees due .....	.....
Inspection Rating Board	\$.....
52. Investigation and adjustment of losses, including arbitration fees and legal and other expenses of hearings and court proceedings .....	.....
53. Payroll audit .....	.....
54. Total	\$.....
<i>Taxes, Licenses and Fees Outstanding:</i>	
55. State tax on premiums at ...%	\$.....
56. All other items on business of this statement .....	.....
57. Total	\$.....
<i>Acquisition Outstanding:</i>	
58. Commissions	\$.....
59. All other* (See * on p. 450).....	.....
60. Total	\$.....
<i>Administration Outstanding:</i>	
61. Outstanding underwriting expenses not listed above†	\$.....
62. Total Liabilities	\$.....

EXHIBIT OF PREVIOUS ESTIMATES OF UNPAID LOSSES.

Total Compensation Losses Outstanding on Dec. 31 of Each of the Following Years as per Item 50, Each Year.	Actual Payments During Each of the Following Years on Accidents Which Occurred During the Periods Covered by the Original Outstandings.					Estimated Future Payments on Account of Said Losses on Dec. 31, 1916.	Revised Valuations, Col. (VI) Plus Col. (VII).	Ratio Col. (I) to Col. (VIII) PerCent.	
	Year.	1913.	1914.	1915.	1916.				Total.
	(I).	(II).	(III).	(IV).	(V).	(VI).	(VII).	(VIII).	(IX).
1912	\$	\$	\$	\$	\$	\$	\$	\$	
1913								
1914							
1915						

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GAIN OR LOSS EXHIBIT.
Receipts.

Premiums:

63. Net written (Item 13)	\$....
64. Add unearned (Item 38 of year previous)
65. Total	\$....
66. Deduct unearned (Item 38 of this schedule) .....	.....
67. Earned premiums	\$....
68. Average of net written and earned premiums; one half the sum of Items 13 and 67	\$....

Losses and Expenses Incurred.

Losses:

69. Net paid (Item 25)	\$....
70. Add outstanding (Item 50 of this schedule) .....	.....
71. Total	\$....
72. Deduct outstanding (Item 50 of year previous)§ .....	.....
73. Incurred losses	\$....
74. Incurred loss ratio (Item 73 divided by Item 67)	%

Service:

75. Net paid safety inspection, etc. (Item 26)	\$....
76. Add outstanding (Item 51 of this schedule) .....	.....
77. Total	\$....
78. Deduct outstanding (Item 51 of year previous) .....	.....
79. Incurred safety inspection and acci- dent prevention	\$....
80. Incurred inspection ratio (Item 79 divided by Item 13)	%
81. Net paid investigation, etc. (Item 27)	\$....
82. Add outstanding (Item 52 of this schedule) .....	.....
83. Total	\$....

§ If the revised valuation of the outstanding losses of the year immediately preceding, as indicated in Column VIII of the Exhibit of Previous Estimates of Unpaid Losses in this schedule, differs from the amount listed under item 50 of last year's schedule such revised valuation shall be here substituted for the earlier estimate. Has this been done? Answer

STUDY OF WORKMEN'S COMPENSATION SCHEDULE "W." 453

84. Deduct outstanding (Item 52 of year previous) .....	.....
85. Incurred investigation and adjustment of losses, etc.	\$....
86. Incurred adjusting ratio (Item 85 divided by Item 67)	%
87. Net paid payroll audit (Item 28)...	\$....
88. Add outstanding (Item 53 of this schedule) .....	.....
89. Total	\$....
90. Deduct outstanding (Item 53 of year previous) .....	.....
91. Incurred payroll audit	\$....
92. Incurred payroll audit ratio (Item 91 divided by Item 68)	%
93. Total incurred service ratio (Sum of ratios under Items 80, 86 and 92)	%
<i>Taxes, Licenses and Fees:</i>	
94. Net paid taxes, etc. (Item 32)	\$....
95. Add outstanding (Item 57 of this schedule) .....	.....
96. Total	\$....
97. Deduct outstanding (Item 57 of year previous) .....	.....
98. Incurred taxes, licenses and fees	\$....
99. Incurred taxes, etc. ratio (Item 98 divided by Item 13)	%
<i>Acquisition:</i>	
100. Net paid acquisition (Item 35)	\$....
101. Add outstanding (Item 60 of this schedule) .....	.....
102. Total	\$....
103. Deduct outstanding (Item 60 of year previous) .....	.....
104. Incurred acquisition	\$....
105. Incurred acquisition ratio (Item 104 divided by Item 13)	%
<i>Administration:</i>	
106. Net paid administration (Item 36) ..	\$....
107. Add outstanding (Item 61 of this schedule) .....	.....
108. Total	\$....
109. Deduct outstanding (Item 61 of year previous) .....	.....
110. Incurred administration	\$....
111. Incurred administration ratio (Item 110 divided by Item 68)	%

Summary:

112. Total incurred expense ratio (Sum of ratios under Items 93, 99, 105 and 111) ¢
113. Total incurred loss and expense ratio (Sum of Items 74 and 112) ¢
114. Ratio of underwriting profit or loss (difference between ratio in Item 113 and 100.0%)..... ¢
115. Estimated amount of underwriting profit or loss under earned premiums (Item 67 multiplied by ratio under Item 114) \$....

The first division of the proposed form is entitled "Receipts" and, like the annual statement, consists of a calendar year record of items of income, which, in an underwriting exhibit of this class, is composed entirely of premium amounts. The item, appearing on line 12 and entitled "Dividends to policyholders, less assessments," is inserted for the purpose of bringing the premiums of mutual companies to a net figure, in order to place loss and expense comparisons on a correct basis. As the premiums are reported on the issued basis, this dividend item should be the amount declared during the year, as otherwise the record might be confused in some instances by reason of the necessity of treating the unpaid portion of such an item under "Liabilities." There will be even greater need of such an item should mutual companies find it necessary during the next few years to increase their rates in order to make possible the payment of dividends to their policyholders. Any such increases above the levels established would otherwise result in erroneous comparisons. The arrangement of the premium items is such that there appears on line 5 an amount which may be compared with that under line 8 for the purpose of estimating the future net increase or decrease in premiums due to payroll audits or other causes. This is important by reason of the fact that Schedule "Z" which consists of audited business only cannot exhibit current loss ratios and consequently they must be checked up by reference to this schedule, which consists of more recent business, some of which has not yet expired and which can be placed on an estimated ultimate basis only after making a careful study of current and probable future developments. For internal purposes, the companies should go further than this and keep a record of additional and refunds and also of notices of accidents, by years of issue and by state, as more accurate estimates can be made from such sources. It does not seem necessary to incorporate this feature in the schedule, however.

The "Disbursements" division is largely self-explanatory and consists of a calendar year record of cash expenditures as does the similar section of the annual statement.

Under the group entitled Losses the individual items have been subdivided in such form that if any compensation law is amended as to a particular benefit the value of the change can be most readily ascertained. The items have been so arranged that line 19 gives a total of what might be termed compensation payments to injured workmen and their dependants, as distinguished from medical aid, while lines 21, 23 and 25 also give totals which will frequently be desired in connection with comparative analyses.

Under the Service group the items appearing on lines 26, 27 and 28 should include here, as they do in the annual statement, a proper proportion of the overhead charges such as salaries, rents, postage, etc. The items composing the adjusting charge are outlined in detail in the footnote (d) appearing in connection with Schedule "P" in the annual statement. The following method of apportioning unallocated loss expense between lines of business is suggested for the reason that it has been found to produce amounts which fluctuate between the liability and compensation lines in accordance with the service rendered during a given period of time. Charge all unallocated legal claim expense to the liability business under which it is accrued. Apportion the balance of unallocated adjusting expense between the two lines by the use of the following amounts: compensation claim payments in toto; liability unlitigated claim payments in toto plus one fourth of the liability litigated claim payments. Safety inspection and payroll audit items should also include a proper provision for overhead expense. Unlike losses, the items in this group cannot always be directly allocated and, consequently, each company should report only that portion of those charges and the proportionate overhead applicable to compensation business of the state for which the report is being made up. This limitation as to state location of risk holds true as to all portions of the schedule.

The group headed Taxes, Licenses and Fees is also self-explanatory, including as it does only a proper portion of those charges which are specifically designated as such in the annual statement.

The Acquisition group consists principally of commissions, although in the case of companies operating under the branch office system of agency organization the commission charges do not cover

certain overhead items and the latter correspondingly increase in importance. In the case of branch office companies considerable amounts of acquisition expense appear under general headings such as rents, etc., in the annual statement and as this is the opposite method of treatment from that accorded to Service items some apportionment is necessary. The amount of such expense should be determined by the reporting company and excluded from any amounts used as a basis for determining the administration charge. Unless this is done neither the acquisition nor the administration expenses of branch office companies will be obtained upon a basis properly comparable with those of general agency companies.

The Administration group should include all underwriting expenses for which specific provision has not been made heretofore. In the foregoing, underwriting expenses include only those having to do with the insurance end of the business, and exclude all investment items.

The division entitled "Liabilities" should include such portions of similar items appearing in the annual statement as are chargeable to the compensation business of the state under observation. In order to accomplish this, items 32, "Salaries, rents, expenses, bills, accounts, fees, etc., due or accrued," and 33, "Estimated amount hereafter payable for federal, state and other taxes based upon the business of the year of this statement," on page 5 of the annual statement should be subdivided more specifically and the items obtained apportioned or charged direct as the case may be to the business of this schedule. In explanation of the necessity for this action it may be stated that in the case of one company item 32 above mentioned is found to consist of inspection service 16 per cent., payroll audit 10 per cent., acquisition 60 per cent., administration 10 per cent., and items chargeable only to lines of business other than liability or compensation 4 per cent. As regards item 33 of the annual statement, no difficulty should be experienced in dividing it so as to show separately premium taxes and all others. With these requirements in mind we may proceed to discuss the specific groups within this division.

That group headed Premiums Unearned should of course be compiled for this subdivision of business by the use of the same methods applied in obtaining the total item which appears in the annual statement.

The next group, which covers Losses Outstanding, is subdivided in

the same manner as the disbursement item. There is an added reason for doing so in the fact that loadings for underestimate can be more accurately estimated if this is done. This phase of the situation will be taken up in a later paragraph.

Under the Service Outstanding group the inspection and payroll audit items should each be proportionate parts of the amounts appearing therefor in item 32, page 5 of the annual statement. The Adjusting item should be a proportionate part of item 17, line 5 of the same statement. The best method of obtaining this item seems to be to multiply the amount of losses outstanding by the ratio of paid losses to paid adjusting and to then make a deduction for any preliminary work such as investigating which may have been completed prior to the time of statement.

The items appearing within the group Taxes, Licenses and Fees Outstanding should be obtained by taking proper proportions of the amounts constituting item 33, page 5 of the annual statement. Care should be taken, however, to see that the outstanding premium tax includes the total amount accrued and unpaid upon the basis of premiums written, including those which are not yet paid. Otherwise, an improper comparison will be made in the Gain or Loss Exhibit.

The Acquisition Outstanding group should include commissions upon all uncollected premiums at the rates stated in the policies. The balance of the acquisition cost outstanding should be a proper proportion of the amount which constitutes a part of item 32, page 5 of the annual statement.

The group styled Administration Outstanding should consist of a proper share of the total amount of administration included in item 32, page 5 of the annual statement.

The division headed "Exhibit of Previous Estimates of Unpaid Losses" is intended to serve as a reasonable check upon the accuracy of the estimates of previous years. The amounts entered in column (I) represent the loss reserves carried at the close of the years specified and these figures are compared with those appearing in column (VIII) which contains the total of subsequent payments under such accidents and the latest estimates of outstanding thereon. There should be included in columns (II) to (VIII) inclusive all amounts accruing under notices of accidents which happened prior to the dates of the original estimates whether or not they were included in the first instance. The ratio appearing in

column (IX) indicates approximately whether or not subsequent experience proves the accuracy of original estimates. It is true that columns (I) and (VII) are present values and columns (II) to (VI) are actual payments, for which fact allowance should be made. Footnote § contemplates the use for the latest year shown of the item which appears in column (VIII) and, as only one year's actual payments are involved, there would seem to be no serious objection to its use as the situation produced is no different from that found elsewhere in the statement. In actual practice, an examination of this exhibit will for early years of compensation business indicate a considerable underestimate of outstanding losses and the necessity for a loading to cover that factor. If individual estimates are conscientiously made by claim adjusters such a condition will necessarily exist. This is due to the fact that at the time of estimate some accidents will not have been reported and others will not have developed to their full degree of seriousness. Such a loading of individual estimates can best be made by dividing the losses outstanding into items similar to those which appear in the proposed schedule under the group entitled "Losses," i. e., medical aid, temporary total, death, etc. Under these divisions groupings by years in which accidents occurred should then be made. When this has been done loadings can be applied to each group graded according to the age of the case and the character of the injuries. Careful observation of the results of the past few years of business and the relative amounts of later estimates as between items should enable one to produce results which will be reliable. The advantages of such a method as contrasted with a flat loading of the total losses outstanding is that it gives proportionate weight to each of several fundamental influences. For instance, it is obvious that more recent and, consequently, less fully developed cases will require heavier loadings than those of earlier origin and that the same relation will exist between the estimates of the cost of minor injuries, such as temporary total, and those for cases calling for the payment of more clearly defined benefits, such as accrue under the fatal and specific dismemberment provisions.

The "Gain or Loss Exhibit" division of the schedule is largely a recapitulation of preceding figures. It is by far the most important part of the schedule, exhibiting as it does final results in that form which most readily permits of comparisons—by means of

ratios. The standard arrangement of items and groups of associated items as to order of sequence throughout the other divisions was intended to fit in with and to facilitate the compilation of this division in its most useful form. The value of the results is due to the fact that the ratio or ratios obtained in connection with each group of associated items result from comparisons with the particular premium groupings to which they are related. For instance, the incurred loss and adjusting ratios are obtained by comparison with the earned premiums. Inspection, tax and acquisition items are related to written premiums as they have been compiled upon a basis which renders them comparable with that item only. Payroll audit and administration expenses have been applied against the average of the written and earned premiums for the reason that in the event of a sudden change in volume of business such a basis is preferable to either a written or earned one. Another factor contributing to the value of the results is that the arrangement of the groups and the associated items therein is such that one may see at a glance upon a correct basis of comparison the ultimate loss, service, tax, acquisition and administration ratios and, in addition, the ratios of the three specific items constituting the service group. It also shows at a glance whether or not the $17\frac{1}{2}$ per cent. acquisition or the total expense limitations have been exceeded. The total of the loss and expense ratios being given, the ratio of underwriting profit or loss is obvious. This ratio furnishes the means by which the estimated amount of underwriting profit or loss in connection with the premiums earned is determined. It does not seem advisable to attempt an adjustment providing for the effect of future additional or refund premiums in the schedule but the same might well be made a subject for special consideration.

As the value of the return is absolutely dependent upon its accuracy and any state record of an individual line of business involves the apportionment of many items of expense, it is of vital importance that the data called for shall be of such a nature and in such form as to assure its accurate compilation. The facts brought out in the foregoing forms all constitute essential information and consist of a careful selection and arrangement of what experience has shown can be obtained in reliable form from properly constituted accounting records. Further expense incident to the compilation of any additional data should be avoided so far as pos-

sible and no such data should be called for, unless it is demonstrated in advance that it can be compiled so as to give accurate and consequently valuable rather than misleading indications.

It is as a result of a full realization of the many practical difficulties with which we are met that the suggested forms have been submitted. It is hoped that a thorough discussion of the underlying principles of insurance accounting and practices which are involved will be productive of results beneficial to all those interested in the compilation or use of this important schedule.

ORAL DISCUSSION.

MR. I. M. RUBINOW: Mr. Goodwin's paper really discusses all the problems in cost accounting in the casualty business. There are a great many questions that may be raised in connection with the suggestions made. Some of them, I think, are questions of detail, as, for instance, apportioning the payroll.

I just want to raise one essential problem; that is, the purpose of this blank is to be a gain and loss exhibit. I take it, it is not for financial purposes, I mean for determining the solvency of the company, because that would have to include all lines of business in all states. For that purpose the financial statement itself is available. The purpose of this blank is to determine the financial results of casualty business in various localities along specific lines—some sort of a check on the general level of premiums.

The plan submitted is an improvement on Schedule W furnished in the past by Massachusetts, New York and Wisconsin, but, notwithstanding, it fails entirely in its purpose. To illustrate, let me give you the story of one of our schedules—I still say "our" Schedule W—of the Ocean Accident and Guarantee Corporation, with which I was connected. I sent in Schedule W of 1914 showing a loss ratio in Wisconsin of something like twenty-eight per cent., which I knew myself was incorrect, but which was the mathematical result of the figures stated accurately. Mr. Downey, then with the Wisconsin Industrial Commission, went up in the air, that we should rob the people of so much excess of premiums over losses as the schedule seemed to indicate. I pointed out to Mr. Downey that while the schedule answered his request it failed to show the true loss ratio—that in order to obtain the actual loss ratio it was necessary to combine Schedules W for 1913 and 1914; then you have a fairly accurate picture. The reason for our Schedule W in 1914 showing so low a loss ratio, and 1913 showing so large a loss ratio was two very disturbing factors. Those two sources of error were, first, the possibility of inaccurate estimates on losses, and second, the point Mr. Goodwin referred to and passed over, the question of additional payrolls. The supplementary statement in Schedule W demon-

strates any possible error in the loss estimates. Of course, you may start with an error which will reduce your loss ratio for a year if you begin with underestimates. You begin with a case which looks like a serious case, and you make an estimate of five thousand dollars, on which the man refuses to die, and you find that your loss is small. There are other cases on which the total estimated loss is one thousand dollars. You close business in that state with a total loss of four thousand dollars, and you suppose you have made two thousand dollars on accidents in that state, which, of course, is an absurdity. You can adjust for that error, and you should, I think, carry over the corrections made in that supplementary statement into your account of what happened from year to year in the particular locality.

The second thing is your fluctuations in uncollected payroll premiums. To begin with, there is a serious difference between companies, some insisting on larger deposit premiums and some being satisfied with smaller deposits. If you will remember the footnote on page 2 of the financial statement giving the amount of premiums due for the past year, you will find that the total of that amount to the total premiums varies substantially. The Ocean had a very large amount as compared with other companies, because the system grew up of writing business on small deposit premiums. In 1914 we collected on that Schedule W in Wisconsin a very large amount of premiums that really were earned in 1913, because 1913 was a busy year. We were reasonably sure we were not going to collect in 1913 anything like the amount we had collected the year before. The sum total of it is that we showed an earned premium that was excessive, and a loss incurred which was too high. Of course, under those two conditions you have a loss ratio that is absolutely wrong. It is true that at the time you make out Schedule W you cannot tell what the schedule at the end of the year will be, but you can make corrections at the beginning of the year. When you make out Schedule W for 1915 you know how far your figures for 1914 were away from the truth, and you have to make a correction for that to begin with; and three or four months later you can make a substantial correction for Schedule W at the end of the year. If you make those corrections you might secure a true report of what has happened; and if you do not get a correct report, Schedule W is scientifically worthless.

In the Ocean I have tried to ascertain those quantities. It, of course, necessitates a certain amount of clerical labor, which is not prohibitive, as it probably kept one clerk busy for several months. When the payroll reports begin to come in, they may be divided into three classes, some coming in January, February and March; especially January and February are all earned the year before. You have a policy in March that had expired in December with a net additional premium of a few hundred dollars on it—every cent was earned the year before, and to enter that in the year coming is an accounting error, and we are dealing with accounting problems.

There is the third group that has been entirely earned in the current year. That does not present any difficulty. The difficulty is on an additional premium on a policy which runs over from one year to another. If you wrote a policy from February to February at a hundred dollar deposit and collected another two hundred dollars, which is not at all uncommon, the difficulty is how much of that two hundred dollars was earned in the year you collected it, and how much the year before. I have assumed that the total premium of the risk was earned uniformly through the year, and I think that assumption, on the whole, will hold more or less, considering the policies that expired at all times during the year. I was able to prove that some sixty to seventy per cent. of all the additional premiums collected the first six months of the year were really premiums earned the year before, and unless you make those corrections, Schedule W is not scientifically correct.

MR. EDWARD S. GOODWIN: Dr. Rubinow's discussion convinces me that a more thorough explanation of the purposes of my paper is desirable.

One purpose was to originate a form of return carefully arranged and subdivided so that proper portions of the specific items composing the annual statement of any company could be transferred directly to it without any confusing or intermingling of unlike items. In other words, a systematic and orderly system of accounting was sought.

Another was to provide within the schedule, if practicable, and if not, by other means, for the proper treatment of items which at the time of the statement might not have developed to an ultimate basis.

The third was to set forth in the Gain and Loss Exhibit the necessary data in such order of sequence and so arranged by groups of associated items that when any information was desired, time would not have to be wasted in the making of more or less complicated recapitulations. Such an arrangement implies a treatment of the various items involved which will place them on a correct basis. For convenience, the results appear in the form of ratios.

Having in mind the limitations which arise from the necessity of setting forth a method to be applied without modification to the individual business of each of the several companies, the proposed schedule appears to be adapted to the purposes for which it was intended.

Dr. Rubinow states that the proposed blank is an improvement over previous forms but questions the reliability of the final results. He evidently refers to the fact that certain of the items composing the schedule have not and cannot have reached an ultimate stage of development at the time of statement and that consequently an unavoidable element of uncertainty exists. That this is to a limited extent true does not constitute a criticism of the proposed form so far as respects the arrangement thereof. Consequently, the follow-

ing remarks are limited to the suggested treatment outlined in connection with undeveloped items.

It is to Schedule Z that we must look for correct ultimate loss ratios. Schedule W provides the record of expenses and in addition furnishes the first approximate indication of the loss ratio under current business. To that extent only can it be expected to supplement the more reliable loss data developed by the former return.

The record of losses outstanding under Schedule W must for some time to come result from individual estimates of the specific cases. We have used the method of loading outlined for two years with satisfactory results. It recognizes the principal determining factors, which are the age of the case and the character of the injuries. As a case develops more accurate estimates are possible and, in like manner, more reliable estimates can be made of specific benefit cases than of those not so rated. A careful examination of estimates will throw light upon their relation, as respects accuracy, to those of a previous period and the further recognition of the above factors will result in estimates sufficiently accurate for the determination of current loss ratios.

The effect of premium changes resulting from payroll audits has, in my estimation, been exaggerated. It is unfortunate that the schedule must be uniformly applied to all companies, as this prevents us from treating this item in the schedule. Unless a company follows the regrettable practice of habitually writing business for advance premiums less than those which should be obtained the effect of this factor will be limited to reasonable bounds, particularly if some estimate of the ultimate is furnished as a supplement to the regular schedule. Fortunately, the ratios representing the commission and tax portions of expenses are on an incurred basis and thus will follow the course of and will not be affected, as to their accuracy, by payroll audit returns. They constitute a considerable portion of the expense charge. The other expense items would be affected and it is for that reason that it is suggested that each company should be requested to submit some estimate of expected premium developments. If such a return indicated 5 per cent. greater ultimate premiums, the only change in the schedule required would be to divide the loss and expense ratios already obtained (except commissions and taxes) by 105 per cent.

From the foregoing it may be seen that the schedule in its final form is as complete as prevailing conditions will permit. The above remarks call for no change of procedure. They merely emphasize the importance of what was in the first instance deemed to be the best method of overcoming certain difficult and unavoidable features of the problem.

MR. CLAUDE E. SCATTERGOOD: I would like to ask Mr. Goodwin if he does not think that the plan outlined in my paper, entitled "Cost Accounting in Casualty Insurance" (*Proceedings*, Vol. II,

p. 253), would not give a more accurate apportionment of unallocated claim expense than the arrangement by apportionment as indicated in his paper? A great deal of claim expense in the liability business is incurred to avoid loss and therefore it would not be accompanied by a corresponding denominator. Also, should his statement, "Further expense incident to compilation should be avoided," be construed to mean that the expense of cost accounting should be avoided?

MR. EDWARD S. GOODWIN: Replying to the latter part of Mr. Scattergood's discussion first, it may be stated that the warning regarding additional expense was merely intended to call attention to the fact that it is economically unwise to call upon the companies to furnish exhaustive data unless the same is first carefully considered and found reasonably certain to produce results which would not be misleading but which on the contrary would be of sufficient value to warrant the necessary effort.

The method of apportioning unallocated claim expense outlined by Mr. Scattergood in his paper is an excellent one. That here outlined has been found to produce reliable results and has the additional advantage that very little work is involved in its application. The close uniformity of the results obtained in connection with a decreasing volume of liability and an increasing volume of compensation payments was not accidental. Compensation payments being made weekly the loss expense thereon follows the amount of total payments very closely. The cost of investigating and adjusting liability unlitigated cases which are settled rather promptly in like manner follows the total payments. It is true that the expense in connection with liability suits does not necessarily follow the settlements but the overlap will average up fairly well and in the final analysis this is a minor matter, these settlements being reduced to one fourth in size before being used for apportionment purposes. As a matter of fact, suits take only a moderate amount of adjusting expense as most of the work in connection therewith is done by attorneys and charged to legal claim expense.

This method of apportionment follows the claim payments, which in the final analysis determine adjusting costs. Giving due weight to each of the different classes of claims, it is particularly well adapted to conditions like those now existing when the proportionate volumes of the various classes of claims are rapidly shifting. No method of apportionment based on premiums only can accomplish this, particularly if the loss ratios and premium rates are also changing as is now the case. In other words, the method recognizes the fact that adjusting costs must inevitably follow the trend of claim payments.

MR. JOSEPH H. WOODWARD: I was very much interested in some of Dr. Rubinow's comments on Mr. Goodwin's paper, and it seems to me the discussion of the valuation of outstandings emphasizes the necessity for the adoption by all companies of some kind of a

mechanical system for valuing outstanding losses as distinguished from individual estimates. I don't believe that individual estimates will ever give adequate reserves. They have been tried for a great many years in the liability business, in the surety business, and in other branches of casualty insurance, and the whole history of estimated losses has been a history of underestimates. Possibly one reason for this is that the claim adjusters have been called upon to furnish these estimates, and a claim adjuster will almost invariably underestimate a loss. He is compelled to psychologically protect himself by minimizing the loss. It seems to me that as the various state requirements become more numerous, and as the companies are called on to file statements in different states similar to the Massachusetts Schedule Z and the Wisconsin schedules, they will be compelled to resort to some sort of a mechanical method of valuation, and by that I mean some such method as that described in Mr. Fondiller's paper. The experience of the New York State Insurance Fund with that method has been on the whole very satisfactory.

One point that was made by Dr. Rubinow I am afraid I cannot agree with. I think it is his idea that in the returns in Schedule W it would be preferable to correct from year to year the outstandings as of the beginning of the year as of which the schedule was being compiled. Now I think that is a very dangerous proposition. Just as soon as you let a company start correcting its outstandings as reported at the end of the previous year, you immediately lose control over the actual progress of the accounts. If you compel the company to always start the beginning of the year with the estimates furnished at the end of the previous year, then underestimates are properly penalized and in the long run compensated for. Certainly, if any corrections are permitted in outstanding items brought over from the previous year, it seems to me they should be specified in great detail. The same problem presents itself in underwriting and gain and loss exhibits. If you let a company correct its outstandings in the gain and loss exhibit, you will never know whether the gain and loss exhibit is right or not. You have no measure of the accumulative error that may be introduced. If, on the other hand, you require the closing items of the previous year to be carried over dollar for dollar without any change, then it is clear that in the long run the aggregate figures must be correct.

The other difficulty mentioned, viz., the question of what to do with additional premiums, seems to me more troublesome. It is quite a problem to get into the accounts of a particular calendar period, receipts which it was not known were due the company until the succeeding calendar period. It seems to me that with a schedule devised for a particular purpose, like Schedule W, it might be wise to call for a footnote giving an estimate of these additional premiums in some such manner as Mr. Goodwin suggests, but I doubt the advisability of requiring them to be actually brought into the accounts showing profit and loss.

MR. EDWARD S. GOODWIN: Lest there be a misunderstanding regarding individual estimates, it should be stated that death and specific dismemberment cases make up a considerable portion of the total estimates and for that reason the individual amounts are in the main fairly accurate and not merely an adjuster's best guess.

The correcting of last year's outstanding losses in this year's Gain and Loss Exhibit is for the purpose of obtaining in its most accurate form the incurred loss ratio of the most recent year of business. This is what that portion of the schedule should show, as otherwise it would exhibit a result which would misrepresent current conditions. It could be shown both ways but that might easily result in confusion. This procedure would not result in any less careful check being maintained upon previous estimates of outstandings as provided in another portion of the schedule.

THE CLASSIFICATION OF INDUSTRIES FOR WORKMEN'S COMPENSATION INSURANCE—E. H. DOWNEY.

VOL. II, PAGE 10.

WRITTEN DISCUSSION.

MR. W. N. MAGOUN:

Many of you who are in attendance at the meeting of the Society today have probably heard me make the remark that ten years hence, when we look back at the events of today, we shall realize perhaps more than it is possible for us to do right now, that in the year 1916 we were in our infancy in many matters pertaining to workmen's compensation.

True, wonderful progress in this field of insurance has been made during the last five years. The growth and development have been remarkable. It is not surprising, therefore, that although Dr. Downey's paper is yet scarcely a half year old, already history records changes of importance in several directions.

Experience-actual figures based upon real claim records is accumulating like a ball of snow rolling down hill, and that other kind of experience, namely, that which comes to individuals and is gained by everyday constant contact with events transpiring in the whole field of compensation, is accumulating in no less measure.

To discuss the "Classification of Industries for Workmen's Compensation Insurance" means in reality to discuss the Manual of Workmen's Compensation Rules, Classifications and Rates. It is a hobby of mine to put the "rules" first, for unless we have clear cut, workable rules the classifications and rates cannot be equitably applied.

An event which I believe will always be looked back upon as one of the notable landmarks, took place the latter part of the year

1915, namely, the Joint Conference on Workmen's Compensation Insurance Rates.* Although the title does not so indicate, the Conference carefully considered the rules and classifications as well.

The Rules Committee devoted its principal energy to the "Division of Payroll" Rules. As stated by the Committee "this is a subject which has caused a great deal of trouble in the past, it was carefully considered by the Committee and important changes made."

I believe that the rules as revised remove some of the objections raised by Dr. Downey. They attempt to make clear in respect to all classifications the question of whether or not a payroll should be divided. Although permitting somewhat more division than the former rules, they are more satisfactory in that they eliminate the option to "divide" or "not to divide" and specify that if "there are 'distinct enterprises' conducted in a given plant by the same employer and the entire work in each enterprise is conducted either in a separate building or on a separate floor or floors of a building, the employer conducting each of such enterprises as a separate undertaking with separate records of payroll, then such separate undertakings shall each be classified according to the Manual and the proper premium rate applied to each."

This rule is in line with Mr. Mowbray's discussion of Dr. Downey's paper. The Massachusetts Rating and Inspection Bureau has added to the rule for payroll division the words "meaning thereby operations which are specifically classified in the Manual" as defining even more clearly the exact significance of the words "distinct enterprise" and the Pennsylvania Compensation Rating and Inspection Bureau similarly interprets the rule.

At the suggestion of the Rules Committee of the Conference, every page in the Manual whereon appear any classifications, bears the words "See Division of Payroll Rules, pages 7 to 11 inclusive." This very important subject, therefore, would appear to have received the recognition and publicity to which it is entitled.

The new Manual is better than its predecessor in other ways. Dr. Downey criticizes, and properly in my opinion, such an inclusive class as "Electric Apparatus Mfg." A similar case would be "Plumbers' Supplies Mfg." Although the former classification is still retained, a means of dealing with classifications of this type is illustrated by the handling of Plumbers' Supplies Mfg. This classification now appears in the Manual as follows:

- "Plumbers' Supplies Mfg.:
- "Enamelled Iron Ware Mfg.
- Porcelain Ware Mfg.
- Pipe Mfg.—lead
- Pipe Mfg.—cast iron.
- Pipe Mfg.—wrought iron

* See "Proceedings of the Joint Conference on Workmen's Compensation Insurance Rates," published by New York Insurance Department, 1915.

Tanks, Seats and Cabinets (wood)
 Valves and Gauges
 Rubber Goods (not otherwise classified)

“If the business of the Assured is completely described by one of the foregoing classifications, the risk must be assigned to such classification.

“Plumbers’ Supplies Mfg. (not otherwise classified).”

The use of a general heading, with several classifications thereunder, is further exemplified by such classifications as

Agricultural Machinery Mfg.
 Chair Mfg.
 Coal Merchants
 Foundries
 Fuel and Material Dealers, and
 Furniture Mfg.

all of which in my opinion tend to improve the Manual for the simple reason that they make it more clear.

Another feature in connection with this Manual, which is growing more common, is the use of explanatory footnotes. The chief objection thereto I assume is in the space taken up, and this is emphasized every time a page is reprinted. The advantages, however, appear to me to more than offset the objections, and I welcome the use of such footnotes. The note pertaining to “Salesmen (outside) Collectors and Messengers” is an excellent illustration as it definitely instructs the user of the Manual how to treat that classification in all its many phases.

That the immediate future will witness the adoption of either of Dr. Downey’s suggestions for the “re-construction” of the existing industry classifications, namely, the “industry-group” or the “operational” or process classification, seems unlikely.

It seems to me reasonably safe to prophesy however that the more extended use of, and improvements in, systems of schedule and experience rating will, if such systems prove their *raison d’etre*, tend materially to modify inequities as between two plants, which, while differing in their operational hazard, fall under the same manual classification.

I referred to this point in my discussion of Mr. Moore’s paper in the *Proceedings*, Vol. II, p. 281. If there are two plants, both manufacturing valves, one producing large, heavy valves, and the other small, light valves, and there exists but one rate for all establishments making valves, is it unreasonable to expect, other things being equal, that the experience of the former will be less favorable than the latter. If this is so, it follows that an experience rating system if properly worked out, will so affect the original base rate for these two manufacturers of valves that the manufacturer of the heavier article will pay a higher rate, and vice versa.

That the future development of rules, classifications and rates for workmen’s compensation insurance will be free from many of the objections raised by Dr. Downey, I believe to be reasonably assured.

Whether this development will proceed too quickly from some points of view, or not quickly enough from others, it is perhaps idle to speculate upon. That a safe and sane middle ground of continuous healthy growth may be the outcome, seems the more likely.

I have already referred to the Joint Conference on Workmen's Compensation Insurance Rates. Before adjourning, this Conference adopted a resolution, advocating the establishment of a permanent conference.

Such an organization is now an accomplished fact. The Insurance Departments of New York, Massachusetts and Pennsylvania appointed a "Standing Committee" consisting of a state insurance department, a state fund, three stock and two mutual insurance companies.

The Standing Committee has met, organized and elected Mr. Harwood E. Ryan of the New York Insurance Department as Chairman and Mr. Leon S. Senior as Secretary, and commenced to hold regular meetings. Representatives of the Insurance Departments of New York, Massachusetts, Maryland and Pennsylvania and of the Workmen's Compensation Service Bureau, Compensation Inspection Rating Board, Massachusetts Rating and Inspection Bureau and the Pennsylvania Compensation Rating and Inspection Bureau may attend its sessions. Each of the aforesaid rating associations has adopted a resolution expressing its willingness to cooperate. The Standing Committee has also invited the California Insurance Department and the California Inspection Rating Bureau to participate.

A central clearing house has therefore been established. The right of each state to make its own compensation rates will not be interfered with. Before adopting a change in Manual rules, classifications or rates, however, each rating association will have the opportunity of presenting such proposed alterations to the Standing Committee and of receiving the valuable advice and help which will come from an organization representing, as the Standing Committee does, all points of view as to what is best for the future, based upon the broad experience of the past.

On the one hand if a change in the Manual of real merit is proposed, all states will benefit. If, on the other hand, an alteration is suggested which may at first appear desirable to the proponent and careful consideration by the Standing Committee discloses a weakness, an undesirable change may be avoided.

Uniformity in phraseology, and substantial agreement as to matters common to all states will be the natural result, while local conditions peculiar to this or that state can readily be handled as "exceptions" as such matters must always of necessity be handled.

We have then at the present moment, just becoming effective, a revised basic manual of rules, classifications and rates for workmen's compensation insurance, and the machinery for effecting im-

provements in the same from time to time, as they may be proposed and after proper investigation and careful consideration be shown to be desirable.

I submit, therefore, that since the presentation of Dr. Downey's paper last October, many of his objections have disappeared, and the handwriting on the wall seems to indicate that even greater achievements are already under way.

NOTE ON THE APPLICATION OF RECENT MATHEMATICAL-STATISTICAL METHODS TO COAL MINE ACCIDENTS, WITH SPECIAL REFERENCE TO CATASTROPHES IN COAL MINES IN THE UNITED STATES—

ARNE FISHER.

VOL. II, PAGE 70.

WRITTEN DISCUSSION.

MR. ALBERT H. MOWBRAY:

Mr. Fisher says in closing his paper, "My chief object in presenting the results was to call the attention of the members of the Society to the practical use of the modern researches on mathematical statistics." It is, however, difficult for the average student to follow this paper because it assumes familiarity with the details of these researches on mathematical statistics. With these the average American student is not familiar because they have been made by German, Swedish and Russian mathematicians whose works have not heretofore been summarized in English and have not been followed very closely in teaching mathematics either in the American universities or to actuarial and other students after leaving universities. Mr. Fisher's recent book "Mathematical Theory of Probabilities" is a first step toward relieving this difficulty, but unfortunately the second volume which, as I understand it, will deal more in detail with the methods used here is not yet available.

Mr. Fisher takes rather serious issue with the teaching of probabilities as they have been heretofore presented to English-speaking actuarial students. As these men have generally heretofore confined their attention to life insurance, where conditions have become relatively more stable the difficulties resulting from this teaching did not strongly present themselves. In our work, however, they are more conspicuous.

The central theme of Mr. Fisher's paper seems to be, "All statistical series are subject to perturbations of various sort of quite different nature than the fluctuations in the ordinary games of chance, which follow the laws of mathematical probabilities. It is one of the paramount duties of the statisticians to try to measure the magnitude or force of such external disturbing influences in a purely quantitative manner." Starting from this point, Mr. Fisher

examines the experience with fatalities in coal mines over a fifteen year period from 1900 to 1914 inclusive, and by the application of his methods reaches the conclusion that there are large "perturbative influences" present. For a clear comprehension of the work given on page 71, a close familiarity with the methods described in Mr. Fisher's book on Probabilities, above referred to, is necessary.

Finding these disturbing elements, he excludes all catastrophes resulting in the loss of five or more lives, and finds by the same method that while the evidence of disturbing influences is reduced, it is strongly present. If I correctly understand Mr. Fisher's theories, this would seem to imply that even ignoring catastrophes involving five or more lives there are yet forces tending to produce great irregularity in the incidence of the isolated fatalities in coal mining work.

Mr. Fisher then takes up a study and comparison of twenty coal mining regions, concluding that there must be great variation from state to state so that it would be improper to apply frequency ratios based upon the experience of the Union as a whole. This study is based upon accidents of one year only, and a brief inspection of the returns would make this apparent without mathematical investigation. Mr. Fisher concludes that because the "coefficient of disturbancy" is imaginary for such states as Michigan and Iowa, there is small fluctuation in frequency from year to year. May not this have been due to the absence of any large accident in the particular region noted during the period under consideration?

Mr. Fisher then takes up the question of frequency of catastrophe hazard, and from a study of catastrophes of what he terms the first magnitude (resulting in the loss of from five to nine lives) he works out a series of probabilities for the number of catastrophes to occur in each year ranging from 0 up to 20. The table on page 77 shows a rather close fit between the computed probabilities and the observed frequency, but the figures on the whole are so small that one is inclined to wonder whether a different series of probabilities could not be determined which would give a considerably different distribution, and yet fit nearly as closely as the figures produced by Mr. Fisher. This is not to be taken in derogation of Mr. Fisher's method. It is a serious question in my mind how far we are safe in relying upon probabilities developed by any mathematical method from limited observations, or intended to apply to rare, infrequent evidence.

In closing his paper Mr. Fisher intimates that the methods used in this paper are more suitable for the solution of the problem, "How Extensive a Payroll is Necessary to Furnish a Dependable Pure Premium," than were the methods used by the writer in his paper, and I am inclined to agree with Mr. Fisher in this regard and trust he may be induced to apply his method to the solution of that problem, which yet remains one of the most important and difficult problems before us.

MR. ARNE FISHER:

AUTHOR'S REVIEW OF DISCUSSION.

Further comment on the remarks by Mr. Mowbray seems rather superfluous except on a few minor points. Mr. Mowbray mentions that the researches of the Danish, Swedish and Russian statisticians are not familiar to the American reader. He might also have added that the biometric methods of the Pearsonian School of England have received far too scant attention amongst assurance statisticians and actuaries in this country. I am further gratified to note that the reviewer has correctly interpreted my ideas of the fundamental principles of the theory of probabilities. In my opinion an *a priori* foundation of the probability theory as given by Laplace is indispensable. Laplace's "Théorie des Probabilités" remains to this very day *the great* work on probabilities. Unfortunately most English actuaries have not recognized its value and often misunderstood its intricate mathematical analysis and have instead followed the Gaussian School of Germany. This deplorable fact may partly be explained by the aversion to everything French prevailing in Great Britain after the Napoleonic Wars, during which period the first editions of Laplace's book appeared. It is to be hoped that the present war may cause a healthy reaction and turn the eyes of the English-speaking actuaries towards the immense wealth of information contained in the work of the immortal Frenchman. It is a fact that the very latest researches on mathematical statistics as carried on by the Englishman, Pearson, and the Dane, Thiele, may be brought to the simple principles found in "Théorie des Probabilités," which has been emphasized by the Swedish astronomer and statistician Charlier.

In regard to Mr. Mowbray's doubt about my coefficient of disturbancy for Iowa and Michigan I may add that all accidents resulting in the loss of five or more lives were eliminated for all the states for which I have computed Lexian Ratios and Charlier Coefficients of Disturbancy. Yet, after reducing all states to similar basis as far as the magnitude—or rather the absence of the magnitude—of catastrophes are concerned, the two states exhibit imaginary coefficients, which can be explained in no other way than by a state of greater stability. This greater stability does not necessarily mean that the average accident frequency is less in these middle states, but it simply indicates a dense clustering about the mean value.

Mr. Mowbray finally states: "It is a serious question in my mind how far we are safe in relying upon probabilities developed by any mathematical method from limited observations, or intended to apply to rare infrequent evidence." If Mr. Mowbray regards observations in the light of exposures the first part of his statement is correct. In regard to the second part I think I can satisfy all doubts by referring to the recent investigations of Bortkiewicz and Charlier, investigations originally started by Laplace and his dis-

ciple, Poisson. When the event is rare, its probability is very small and the ordinary "Law of Large Numbers" does not hold. That is to say, we cannot use the Bernoullian Theorem or the Gaussian exponential. The number of absolute frequencies are on the other hand expressed by the Poisson exponential. Bortkiewicz has shown that statistical frequencies of rare events, following the Poisson Law of Small Numbers, are more stable than the common frequencies. Neither Poisson nor Bortkiewicz use more than one term in the expansion of the B curve series. The parameter γ_2 (the eccentricity) is a measure of the fluctuations from the mean, thus corresponding to the standard deviation, σ , in the A type of curves and gives a closer fit of the curve. Now in regard to rare events, it is a rather paradoxical fact that series of such events present a greater stability than series of more common events. On the other hand, we do not need to know the total exposures to compute the relative frequencies when such frequencies themselves approach zero. The relative frequencies, or probabilities, as determined from the frequency curve may exhibit great deviations when applied in predicting the frequencies of catastrophes for a single year, but the same probabilities will show very small deviations in predictions in reference to a larger period, say a series of twenty or more consecutive years, and this is all that is required.

In regard to the dispersion theory most of the rudiments of this theory are found in the first volume of my book on "Probabilities." A further study of the higher statistical parameters is required in many cases, however.

THE DETERMINATION OF PURE PREMIUMS FOR MINOR CLASSIFICATIONS ON WHICH THE EXPERIENCE DATA IS INSUFFICIENT FOR DIRECT ESTIMATE—ALBERT H. MOWBRAY.

VOL. II, PAGE 124.

WRITTEN DISCUSSION.

MR. HARWOOD E. RYAN:

The method described by Mr. Mowbray for the determination of pure premiums in classifications which, taken singly, do not yield an adequate payroll exposure, contemplates two principal steps. First, the classifications must be grouped in such manner that within any group there will appear only classifications which may be presumed to be closely related in hazard. Second, there must be determined for each classification within each group, its relative hazard as compared with some one classification selected as the standard.

No one can say with certainty how much payroll must be obtained to form a satisfactory group. Nor is there any fixed rule by which hazards of the same kind may be determined. It is clear, therefore,

that the formation of groups and the determination of relative hazard must be, of necessity, a matter of personal judgment. The principal advantage of the method suggested by Mr. Mowbray is that it confines the exercise of personal judgment to comparatively small fields, thus rendering it as accurate as humanly possible. Of the two divisions of the problem the qualitative portion is of course the easier. Less difficulty will be found in the formation of the groups than in the determination of values representing relativity of hazard.

In practice it may not always prove feasible to establish arithmetical factors of relativity but the experience data can be arranged in ascending or descending order of hazard according to the best available judgment. The group pure premium will then furnish a basis for selecting consistent pure premiums for the several constituent classifications.

Turning now to the arithmetical process employed, it appears that while Mr. Mowbray has attacked the problem in a very ingenious manner, the formula which he suggests will not necessarily reproduce the original losses. A slight error has crept into the figures appearing on pages 132 and 133, the total observed losses being there reported as \$108,250. The correct amount is \$108,500. The particular illustration employed is unfortunate in that the payroll for the classification selected as the standard so far outweighs the payroll for the other classifications in the group that the pure premium for the group is practically determined by the pure premium for that classification. In applying a test to the formula, I have made a slight modification in the hypothetical data given in the table which appears at the foot of page 132, preserving, however, the original pure premiums there developed. I have reduced the payroll and losses for classification "C" to \$8,000,000 and \$10,000 respectively, obtaining the following results, the first according to the original formula and the second according to Dr. Rubinow's modification:

CLASSIFICATION "C" MODIFIED.

ORIGINAL FORMULA.

Classification.	Judgment Rating.	Reciprocal.	Observed Losses.	Mod. to Stand. Basis.	Pay Roll.	Pure Prem.		Projected Losses.
						Original Experience.	Adj. by Formula.	
A...	.50	2.00	\$ 2,500	\$ 5,000	\$ 500,000	.50	.0701	\$ 351
B...	.75	1.33	1,000	1,333	1,000,000	.10	.1052	1,052
C...	1.00	1.00	10,000	10,000	8,000,000	.125	.1402	11,216
D...	1.25	.80	5,000	4,000	5,000,000	.10	.1753	8,765
			\$18,500	\$20,333	\$14,500,000	.1276	.1402	\$21,384

Excess Projected over Actual Losses, 15.6 per cent.

MODIFIED FORMULA.

Classi- fica- tion.	Judg- ment Rat- ing.	Observed Pay Roll.	Corresp. P. R. Standard Basis.	Observed Losses.	Pure Prem.		Projected Losses.
					Original Experi- ence.	Adj. by For- mula.	
A . . .	.50	\$ 500,000	\$ 250,000	\$ 2,500	.50	.0607	\$ 304
B . . .	.75	1,000,000	750,000	1,000	.10	.0910	910
C . . .	1.00	8,000,000	8,000,000	10,000	.125	.1213	9,704
D . . .	1.25	5,000,000	6,250,000	5,000	.10	.1516	7,580
		\$14,500,000	\$15,250,000	\$18,500	.1276	.1213	\$18,498

Deficiency Projected under Actual Losses, .01 of one percent.

It will be noted that the modified formula reproduces the actual losses of the group to any desired degree of accuracy. The same will be true of the original formula by performing one more operation, viz., applying to the projected losses in each classification the ratio obtained by dividing the total observed losses by the total projected losses. Dr. Rubinow's method is more direct and involves the principle of weighting the observed payrolls according to relative hazard, thus reducing the total payroll of the group to the standard basis where the relativity is unity. The employment of reciprocals is not essential. Once having established the various degrees of relative hazard, it is only necessary to apply the factors of relativity to the observed payrolls, then to derive the hypothetical group pure premium and from it the new pure premiums for the individual classifications.

The proposed method is similar to the more obvious one of finding the actual group pure premium, applying the factors of relativity thereto and then adjusting the projected losses produced by the hypothetical pure premiums so as to reproduce the original losses for the entire group, finally increasing or decreasing the hypothetical pure premiums in the appropriate proportions. The following illustration will explain the point more clearly:

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Classi- fica- tion.	Judg- ment Rat- ing.	Payroll.	Observed Losses.	Exp. Pure Prem.	Group Pure Prem. Mult. by Col. 2.	Proj. Losses Resulting from Col. 6.	Ratio of Actual to Proj. Losses.	Col. 6 Ad- justed by Col. 8.	Proj. Losses Resulting from Col. 9.
A . . .	.50	\$ 500,000	\$ 2,500	.50	.0638	\$ 319		.0607	\$ 304
B . . .	.75	1,000,000	1,000	.10	.0957	957		.0910	910
C . . .	1.00	8,000,000	10,000	.125	.1276	10,208		.1213	9,704
D . . .	1.25	5,000,000	5,000	.10	.1595	7,975		.1516	7,580
		\$14,500,000	\$18,500	.1276		\$19,459	.9508		\$18,498

Error = .0001 per cent.

If any group should contain one or more classifications yielding dependable pure premiums, the pure premiums for the remaining classifications in the group could be established even more directly by simply multiplying the dependable pure premiums by the factors of relativity. In groups which contain a number of minor classifications, no one of which can be said to yield a dependable pure premium, it is, of course, necessary to utilize the entire experience of the group in order to obtain the necessary standard of measurement. A point which Mr. Mowbray brings out and which should be emphasized, is that in determining rates based upon experience, the work should be checked up group by group so that the projected losses derived from the selected pure premiums will reproduce the observed losses.

Mr. Mowbray has rendered a real service in calling attention to the need for an orderly procedure in utilizing experience data as a substitute for the present hit-and-miss practice of selecting classification pure premiums regardless of their possible inconsistency in comparison with others. Even if it should prove impracticable to apply the suggested formula, as modified by Dr. Rubinow, I believe that the fundamental principles involved therein can be utilized by first classifying the data in broad groups and then following the suggestion to further limit the application of judgment by arranging the classifications according to their probable relative hazard in either ascending or descending order.

ORAL DISCUSSION.

MR. LEON S. SENIOR: I just want to refer a moment to Mr. Ryan's discussion. I noticed Mr. Fisher's statement in his paper today, that the underwriter should be entirely eliminated from the study of rate making, and leave it all to the statistician. It was, therefore, rather refreshing to me to note that Mr. Rubinow suggested that the theory which Mr. Mowbray introduced is rather dangerous for the reason that it would leave too much judgment to the safety engineer. Presumably, in the President's opinion, the judgment should be left to the underwriter, as I take it. That is, Mr. Mowbray would leave it to the safety engineer and Mr. Rubinow says it is rather dangerous. I don't believe the President has stated his reasons. Do you think that in the selection of the pure premiums of those classifications, it is preferable to leave the matter to the judgment of the underwriter rather than to the judgment of the safety engineer?

MR. I. M. RUBINOW: It is unfortunate that I should be called upon to answer that question, because I didn't put it up that way. I did not try to draw any comparison between the judgment of the underwriter and the engineer. My criticism was directed to Mr. Mowbray's plan of being only able to assign a difference in value to the hazards between small groups. I think that is a rather danger-

ous procedure as it worked out. As pointed out by Mr. Ryan, it would probably make all the other rates in the several classifications be entirely dependent upon the rates of the governing classifications to which it was approximated, except as rated up or down by the safety engineer, whose judgment would not be much better than that of the underwriter. We ought to eliminate individual judgment as far as possible, anyway.

What I did want to point out is that if we accept Mr. Ryan's idea as expressed in his discussion, we would not use the differential at all. You would have to fall back on the experience in different states, and then we would be confronted with the problem of insufficient payroll exposures, and the only solution offered is Mr. Mowbray's method. Whether the rating is furnished by engineers or underwriters it makes little difference; anyway, it is going to make a rough start in guessing what the hazard is. An engineer will determine whether a machine is hazardous or not, and his engineer's judgment ought to be valuable in preventing particular hazards. I don't trust much to quantitative judgment of engineers' estimates, even on individual machines, and especially on an industry as a whole. I think the safety engineer is not yet used to thinking in quantitative categories. If you put the question up to two or three engineers in different rooms you would get different results.

Let me illustrate the results of this method: you know the United States Government publishes estimates of crops, and their method of getting together estimates of crops is quick. You can imagine about ten million farmers, gathering and counting the amount of cotton each farmer collected, and at the end of December we know more or less how much the cotton crop has been; but you can imagine the great difficulty in saying in June or July what the crop is likely to be; yet the government is called upon to make estimates of probable crops in the future, and all our produce exchange transactions depend upon those estimates. You know that fortunes are made or lost on the day on which the cotton crop report is handed out. The method used is to receive estimates from thousands of people and average them by counties, then by states, and the official average must be made from state averages into one national average. They have four statisticians who sit in a room like little children and they are prohibited from talking to each other. They get estimates and figure and load and guess, each one separately, and after those four estimates are gotten together one estimate is telegraphed to New York.

Now, if some such process was introduced, of four engineers making those estimates, I think we would get an honest picture from those estimates and be able to judge whether those estimates are worth very much. Of course, it is not only a question of averages. It is often a question of who the engineer is, with the strongest personality and ability to compel others to accept his estimates.

MR. JOSEPH H. WOODWARD: Concerning the particular point now under discussion: I don't think the discussion of these details ought to be permitted to cover up the tremendous advance in practice which is represented by the acceptance of the theory that after a scale of pure premiums has been constructed for the classifications as a whole, that scale of pure premiums must be multiplied back into the exposures and adjusted so that the aggregate pure premium produced will agree with the aggregate losses. Although that may seem elementary, it is well known that this view has only been recently accepted. At the time, for instance, of the enactment of the Compensation Law in New York that was not done; and, of course, if that is not done, no one dealing with the problem has any means of estimating the aggregate error which has been introduced by what might be called the graduation of the experience among the different classifications so as to smooth out the effect of accidental fluctuations. The problem is in many ways not unlike the problem of graduating a mortality table. The first test that is applied after a mortality table is graduated is to multiply back for the whole table so as to test the agreement between the graduated and ungraduated data. After that is done, then the same test may be made by sections comprising certain age groups. Similarly, a compensation rate manual should conform with such a test, section by section, so far as the volume of payroll exposed permits.

MR. ALBERT H. MOWBRAY:

AUTHOR'S REVIEW OF DISCUSSIONS.

Mr. Ryan's analysis showing two fundamental requirements of the method I have described is entirely correct, and I am glad he has presented it, as it may make clearer the intention of the method. He is quite right in pointing out that in the selection of groups and the assignment of relative hazard personal judgment is required. The real purpose of the method was to, if possible, combine in a scientific way personal judgment and recorded experience, and I am glad to note that he finds the principal advantage to be that it confines the exercise of personal judgment to a comparatively small field, thus rendering it as accurate as humanly possible. I do not wish to minimize the strain which even this formula places upon those who are attempting to determine relativity in hazard. The problem even in its simplest terms is exceedingly difficult.

I had not found any cases where the formula as originally presented caused quite such a deviation in projected from actual losses as in the case Mr. Ryan cites. It is to be noted, however, that in the example he has set, the clash between the relativity of the indicated pure premiums and the judgment ratings is extremely severe. The reasoning I used led to the original formula and until Dr. Rubinow suggested it the simpler formula did not occur to me,

although the results under the modified formula are very much more satisfactory, and as I attempted to show in the note appended to the paper a slight change in the reasoning develops this formula. The example cited in the paper was only one of many worked out and the primary purpose was not so much to show the difference in accuracy of the two methods as to explain the method itself.

Mr. Ryan calls attention to what might be considered a more obvious method which consists in taking the unweighted average pure premium for the group as the basis, applying the judgment relativities to determine trial pure premiums for the classifications projecting the losses, and then carrying the trial pure premiums by a percentage so as to reproduce the losses incurred. When this method is fully carried out in such detail it arrives ultimately at the same result as by weighted average formula. It, however, clearly lacks the finish and elegance of form of the other formula. Under the weighted average formula, proceeding by an orderly method, the final result is arrived at and it is known in advance that unless an arithmetical error has been made no further adjustment is necessary. The method based upon using the unweighted average pure premium for the group is more a cut and fit process, although in actual operation it may be no more work than the direct formula.

Mr. Ryan suggests that, "If any group should contain one or more classifications yielding dependable pure premiums, the pure premium for the remaining classifications in the group could be established even more directly by simply multiplying the dependable pure premiums by the factors of relativity." While the results obtained by this method may not differ greatly from those obtained by the original formula, there seems to be both a theoretical and practical objection to it. From a theoretical point of view it sets a bad precedent in ignoring absolutely the experience upon the minor classifications in fixing their rates. It would seem that, theoretically at least, all the experience available on any classification should have some weight in determining premiums to be charged. From the practical point of view it may be criticized because we would then be compelled to say (assuming we are to deal frankly with our assured) to a group of employers: "We did not use our experience with your classification in determining your rate, but we did use the experience upon another classification which, in our judgment, presented similar, but not necessarily equal hazard, and which did have sufficient payroll exposure. The rate has been made, therefore, as a proportion of the rate on this classification."

Mr. Ryan has suggested that the illustration was rather unusual in that one classification was assumed to have so much larger volume of experience than all the others. The illustration was chosen in this way to answer the suggestion which had been made earlier orally, that a classification which had sufficient exposure

should determine its own pure premium, and should not be brought into such a combination which might seriously alter the premium on that classification. The illustration shows that under any such circumstances of clear dominance the self-determining classification would not be materially changed. If there were several such classifications in a group and the use of the formula did materially change the pure premiums, it would apparently be an indication that the judgment ratings of relativity were erroneous.

REVIEWS OF BOOKS AND PUBLICATIONS.

Industrial Accident Statistics. By Frederick L. Hoffman. Bulletin, United States Bureau of Labor Statistics, Whole Number 157, Industrial Accidents and Hygiene Series No. 5. Washington, 1915. 210 pages.

This bulletin contains a general statement of the accident problem in the United States, summaries of the occupational mortality statistics of the United States census and of the Prudential Insurance Company and of the industrial accident statistics down to 1913 of the United States Bureau of Mines and of the states of New York, Massachusetts, Illinois, and Wisconsin, together with brief notices of European accident experience and an account of the earlier stages of the movement for uniform accident statistics in this country. In appendices are printed a number of official classifications and report forms.

The outstanding result of this survey is the paucity of useful information respecting industrial accidents in the United States. None of the states reviewed had published statistics at all adequate for accident prevention, for insurance rate making, or even for the due administration of workmen's compensation laws. The reports of the United States Bureau of Mines were (and are) on a yet lower level as respects completeness of reporting and intelligence of analysis, with the added drawback of purporting to show an accident rate which rests upon crude and misleading data. For the average number of employes as reported by mine operators is little better than a vague guess, and the product of this alleged average by the reported number of days worked, divided by 300, is very far indeed from giving the true number of full-time workers. Comparisons of accident rates upon such a basis are worse than useless—they mislead the uninformed.

In the absence of any better data, Dr. Hoffman has attempted to throw some light upon relative occupational hazard from occupational mortality statistics. The results are of very limited value. It is well known that the assignment to occupations in death certificates is far from accurate. Neither is an accident and health policy conclusive as to the occupation of the insured at the time of

death. The exposures are not stated, so that no fatality rate can be given. Dr. Hoffman accordingly has fallen back upon the proportion of accidental deaths to all deaths—a much poorer indicium of occupational hazard than the fatality rate from accidents. Worst of all, occupational accidents are not, and from the materials at hand cannot be, segregated from accidents not arising out of the occupation. It is obvious, e. g., that the proportion of accidental deaths among persons of 65 and over can have little relation to occupational hazard. Lastly, the whole number of deaths recorded is in most instances so small that the percentage possess little significance.

It is a pity that the editorial policy of the United States Bureau of Labor does not admit of critical comment upon statistics reprinted from state departments. To publish without comment a table which purports to show that automobile manufacturing is three times as hazardous as paper and pulp making (Page 53), or such an occupational classification as that contained on Pages 72–75, or classifications of industrial accidents by nationality and conjugal condition of the injured, can only mislead the unwary and make the judicious grieve.

It would be utterly unfair, of course, to hold the distinguished editor of this bulletin responsible for the quantity and quality of his materials. In bringing together and analyzing the scanty information available, Dr. Hoffman has added one more to the long list of services already rendered by him to the cause of industrial accident statistics.

E. H. DOWNEY.

The Experience Grading and Rating Schedule. By E. G. Richards. New York, National Board of Fire Underwriters, 1915. Pp. 104.

This book presents a new suggestion for individual rating of fire insurance risks based upon classified experience and inspection judgment scores.

Speaking of present rates the author says in his preface it is a matter of common knowledge “that rates as now made are based upon judgment only and their scientific adjustment to actual experience is impossible.” He makes the further observation, “The actual cost of insuring the component hazards of any particular class of property can never, as I believe, be ascertained.” It may

be noted in passing that this statement, by implication at least, challenges the theory underlying some of our compensation rating schedules and some of our statistical plans for studying accidents by causes.

The author is a believer in classified experience as the basis of fire insurance rates, but points out that this experience gives only average rates. He believes, however, that if state differentials are used to cover different conditions in different states and proper adjustment made for conflagration hazard—and he discusses at length the reasons for such differentials and adjustments—the entire experience of the United States in a class may be studied in certain subdivisions and produce equitable rates for individual risks in that class based upon experience.

He proposes that on inspection each risk be graded on a score of 1 to 10 according to the inspector's judgment of its relative danger (within its class) to a certain group of hazards such as external exposure, etc. There are some five hazard groups in regard to which the risk would be graded. He would then record experience as so subdivided, believes that a period of about five years would yield a sufficient exposure to develop pure premiums for the several grades and classes, and would build up rates from this basis.

He suggests plans of statistical compilations and includes a sketch of Hollerith or Powers Cards to be used in the work.

The weak point in the plan seems to be in the grading resting upon inspectors' judgments. The author points to such grading as practiced by the Manufacturers Mutual nearly forty years ago. He also says:

“A form of survey for scoring or grading each particular risk must necessarily be prepared for occupancy and for each of the other fundamental hazards. Possibly a greater number of grading surveys will, in practice, be found necessary. Suggested forms for grading occupancy, buildings and exposure are in course of preparation but cannot be completed in season for this publication.

“For the grading of towns and cities as to their relative merits of public protection, a most excellent schedule has been formulated, at the suggestion of this author, by engineers of the Fire Prevention Committee of the National Board, and the schedule so prepared has been adopted as the standard system of the National Board for the United States.”

Of course, since fire companies generally do not singly carry an

entire risk, there will be less difficulty from competitive abuse than in compensation insurance, but it would seem not unlikely that competition between groups of companies might cause trouble in this way unless the grading were done by general boards.

There seems, however, in this plan to be a valuable suggestion for compensation actuaries and casualty companies in testing the correctness of results under rating schedules, perhaps replacing Mr. Richards's grade scores by the charge or credit developed by the schedule and studying the experience of groups of risks receiving a certain charge or credit in comparison with the average.

From this and other points of view Mr. Richards's book should be a very interesting study for all casualty actuaries.

ALBERT H. MOWBRAY.

Principles of Labor Legislation. By John R. Commons and John B. Andrews. New York, Harper and Brothers, 1916. Pp. 524.

The increasing number of laws dealing with labor has brought the need of a restatement of the principles on which the various prohibitions and restrictions that seek to protect the worker in industry are based. Under the headings, The Basis of Labor Law, Individual Bargaining, Collective Bargaining, the Minimum Wage, Hours of Labor, Unemployment, Safety and Health, Social Insurance, and Administration, the authors discuss these principles. There is detailed classification and analysis of each subject under numerous subheadings after the historical background of the legislation and the main facts in regard to the need have been made clear. Foreign experience is cited but the emphasis throughout is on American conditions and problems. The subtitles of the chapter on the Minimum Wage indicate the approach: the economic basis, historical development, standards, methods of operation, results, constitutionality. Of each of these classifications there are again numerous subdivisions.

Social Insurance is discussed under the headings of Industrial Accidents, Health, Old Age and Invalidity, Widows and Orphans (Life) and Unemployment Insurance. The authors emphasize throughout the European methods of providing for these conditions, especially those developed in Germany. Two difficulties make voluntary insurance impracticable, low wages and lack of forethought on the part of the worker. To overcome the first, a contribution by the employer is necessary. The second must be

met by compulsion. State insurance is mentioned but not considered fundamental.

The attitude of the authors is frankly progressive. They believe that there are many conditions in industry, detrimental to the workers, that can be remedied by legislation. But the book is practical throughout. It outlines the problem, points out how legislation has been developed to curb it and then examines the effect of such legislation on employer, employee and the public. The enforcement of a law is in each case the final measure of its value—"a law is really a law only to the extent to which it is enforced." For this reason, the main emphasis throughout the volume is on the problems of administration. This subject is also treated in the concluding chapter. Here are discussed the place of the executive, legislative and judicial branches of government in the enforcement of labor legislation, but a greater amount of space is given to the recently developed industrial commission.

The struggle between the fundamental principles of the rights of the individual as guaranteed under the constitution and the police power of the state is clearly shown. It is the problem of determining the limits of these rights that has been one of the important problems of our courts.

A critical bibliography and a list of the cases cited, is appended; these should prove of value to the student.

This volume should become a textbook for college classes. No other book so adequately covers the field with which this deals. Its sphere of usefulness, however, should be wider than this. It should appeal to the citizen, who by it will be furnished with a guide to the mass of bills presented to each succeeding legislature. He will as a result of his reading be better able to judge what is valuable and what is practicable among the measures suggested.

ALEXANDER FLEISHER,

Supervisor, Welfare Dept. Metropolitan Life Ins. Co.

CURRENT NOTES.

Instruction in Social Statistics.

The New York University School of Commerce, Accounts and Finance announces a course in the theory and practice of statistics (chiefly social statistics) for the fall and winter term of 1916-1917. The course comprehends thorough instruction in the elements of statistical method and offers training in statistical practice by means of extensive laboratory exercises. Mr. William A. Hathaway, Assistant Statistician of the American Telegraph and Telephone Company, will be the instructor.

Lectures of Insurance Institute of Hartford.

The Insurance Institute of Hartford has in preparation a course of lectures to be given from October, 1916, to April, 1917, covering the subjects in the examination syllabus of the Casualty Actuarial and Statistical Society. The lectures are planned by the Institute to assist those of its members who will take the examinations of the Society.

Chamber of Commerce Inquires into Social Insurance.

The Committee on Insurance of the New York Chamber of Commerce is investigating the various phases of social insurance in this country and abroad. Special attention will be directed to health insurance. The work is in charge of Dr. John F. Crowell, Executive Secretary.

New York City Police Department Report on Highway Accidents.

The accompanying table on highway accidents in New York City during 1915 was sent to the Editor by Mr. Mills E. Case, Secretary of the New York City Police Department, and is part of that Department's contribution to the literature available on traffic and other highway accidents in the United States. So far as known, these statistics are the first to be published for any American city in such complete form and in accordance with accepted standards

HIGHWAY ACCIDENTS—NEW YORK—YEAR OF 1915.

REPORT OF ACCIDENTS IN WHICH PERSONS WERE INJURED OR KILLED IN THE STREETS, SIDEWALKS, PUBLIC HIGHWAYS, OR ON THE ROADS AND WALKS IN PUBLIC PARKS.

Nature of Accidents.	Accidents.			Persons Killed.					Persons Injured.				
	Total.	Fatal.	Non-Fatal.	Total.	Male.	Female.	Under 6 Years.	6 Years to 16 Years.	Total.	Male.	Female.	Under 6 Years.	6 Years to 16 Years.
Persons struck by—													
Railway trains.....	23	13	10	13	11	2	1	2	11	8	3	1	2
Street cars.....	1,771	77	1,694	77	58	19	8	10	1,730	1,227	503	277	368
Motor vehicles—													
Passenger.....	4,865	177	4,688	178	127	51	27	72	4,830	3,733	1,097	537	1,742
Truck or delivery.....	1,212	105	1,107	105	82	23	15	43	1,136	885	251	144	398
Motorcycles.....	377	...	377	...	...	...	...	...	414	270	144	63	114
Horsedrawn vehicles—													
Passenger.....	249	3	246	3	3	...	1	...	252	167	85	77	92
Truck or wagon.....	2,441	100	2,341	100	75	25	42	37	2,379	1,772	607	629	766
Saddle horse.....	16	...	16	...	...	...	...	...	16	13	3	4	3
Bicycles.....	352	3	349	3	2	1	...	1	357	226	131	71	158
Other vehicles.....	72	1	71	1	1	...	...	...	71	51	20	17	26
Falls and miscellaneous injuries received while riding on, boarding or alighting from vehicles.....	3,026	47	2,979	47	45	2	...	1	3,026	2,230	796	33	149
Falls, etc., while stealing rides.....	313	9	304	9	9	...	1	7	305	296	9	46	212
Collisions.....	2,428	41	2,387	42	38	4	2	5	2,982	2,489	493	46	202
Other accidents to vehicles.....	573	19	554	21	17	4	...	...	779	636	143	10	44
Runaways.....	421	13	408	13	9	4	5	1	483	431	52	23	30
Non-vehicular accidents—													
Falls.....	3,005	24	2,981	30	20	10	...	2	3,093	1,811	1,282	190	411
Hit by falling objects.....	584	1	583	1	...	1	...	1	624	436	188	48	108
Bitten by dogs.....	120	...	120	...	...	...	...	...	125	101	24	26	64
Miscellaneous accidents.....	692	16	676	16	13	3	4	2	708	584	124	59	196
Totals.....	22,540	649	21,891	659	510	149	106	184	23,321	17,366	5,955	2,301	5,085

CURRENT NOTES.

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of statistical practice. During 1915, the Department was enabled to undertake statistical work on a larger scale than had heretofore been practicable. Forms and methods of tabulation and analysis were radically changed. A preliminary statement regarding this important enterprise was published in the Current Notes department of the *Proceedings*, Vol. II, p. 147.

Photograph of the Members at the Sixth Meeting.

The photograph in this number of the *Proceedings* (p. 334) was taken on May 26, 1916, at the Hartford Golf Club, Hartford, Conn. Each member is designated by a number, as follows:

(1) Hess	(11) Senior	(21) Whitney
(2) Buck	(12) Moore, G. D.	(22) Flynn
(3) Williamson	(13) Goodwin	(23) Rubinow
(4) Hodgkins	(14) Farrer	(24) Scattergood
(5) Hammond	(15) Levy	(25) Fondiller
(6) Craig, J. D.	(16) Hunt	(26) Ryan
(7) Craig, A. H.	(17) Garrison	(27) Black
(8) Parker	(18) Kime	(28) Fallow
(9) Morris	(19) Brockway	
(10) Hughes	(20) Woodward	

A REVIEW OF THE SOCIETY BY THE POST MAGAZINE AND
INSURANCE MONITOR.

The following notice of the Society and its *Proceedings* has appeared in the *Post Magazine and Insurance Monitor*, the leading insurance journal of England. (Vol. LXXVII, No. 20, May 13, 1916.)

Casualty Actuarial and Statistical Society of America.

The establishment in 1914 of the Casualty Actuarial and Statistical Society of America marked an important stage in the development of liability insurance in the United States. Its appearance, indeed, might have been said to be overdue, seeing that the business has been transacted there for nearly thirty years. There have been tariff and rate-making associations which have rendered valuable service in the tabulation of experience, the calculation of rates and the formulation of methods for conducting the business, but there remained a wide field for the activities of a society formed to investigate its problems on scientific lines. In this country the few actu-

arial incursions hitherto made into the field of Employers' Liability and Workmen's Compensation Insurance have been distinguished by an uninvited readiness to direct, on theoretical lines not wholly suited to its needs, the energies of those concerned in its practical conduct. But its many difficult problems afford ample scope for the application of actuarial and statistical methods. The prime cost of the protection to be given and the right method of estimating the provision necessary for unsettled claims and unexpired liability are matters especially calling for scientific treatment.

Rate-making as practised by tariff associations is apt to proceed on inaccurate premises. Once the pure cost of the risk is calculated, the selection of the right loading for commission, expenses and profit is a matter of practical business sense. But the pure cost itself has frequently been calculated by somewhat haphazard and rule of thumb methods applied to insufficient data. And we suspect that at times it rests on no sounder basis than a compromise between the conflicting opinions of competing underwriters.

We gladly recognize the large amount of valuable work devoted to this particular subject by individual investigators in America, but we hardly think their views have received all the attention they deserve. The problem of estimating the proper provision for outstanding liabilities is still far from adequate solution, in spite of the work bestowed on it by American casualty insurance managers and superintendents of insurance departments. The laws on the subject of reserves have been framed on the very natural assumption that the experience of the past would be repeated in the future. Unfortunately, this has not exactly happened, and the result has been that methods of reserve based on favorable experience have fallen to be applied when the business was deteriorating. Subsequently, when the insufficiency of the estimates had been discovered, more stringent standards were applied. Their application coincided with apparently improved conditions and the resulting strain on the offices bade fair to become intolerable. To put the matter shortly, low claim percentages due to the rates of premium being adequate were used as the basis of reserve when the premiums had been reduced, and high claim percentages due to the rates of premium being too low were used as the basis of reserve when the premiums had been increased; also a low average cost of claim settlement, derived from a period when conditions were favorable, was used as the basis of reserves when claim settlements were becoming more costly.

Aims of the Society.

The young Society will therefore lack neither work nor opportunity for usefulness, for it has been called into being to satisfy a real need. Its object is expressed as "the promotion of the study of statistics and actuarial science as applicable to casualty insurance." The list of charter members includes the names of most of the well-

known men in the American casualty world—men who have for years made it their earnest study to develop the business on sound lines and who have been pioneers in the endeavor to clear its practise of error. The inaugural meeting was held on November 7, 1914, and there have already been issued four records of the proceedings. These contain papers of interest and value dealing with the problems of workmen's compensation insurance already mentioned, namely, the calculation of correct rates of premium and the establishment of proper methods for estimating the cost of outstanding claims. The solutions of these two problems become to some extent interdependent at an early stage in the existence of the business. So soon as an attempt is made to correct, by means of actual experience, the pioneer rates, based on theory and on the statistics of other countries, it is usually necessary to include as part of the pure cost the reserves for unsettled and undeveloped claims, and if these reserves are either too great or too small the rates of premium derived from the experience will be correspondingly affected. The difficulty is increased by the fact that, even if the calculations are based on the portion of the risk already run off, some assumption must be made as to whether the risk is evenly distributed over the period of insurance, and a fresh element of uncertainty is thus introduced.

It is clear from the tenor of the papers so far contributed to the *Transactions* of the Society that its members are fully alive both to the difficulties and the vital importance of the two main divisions of the subject. The following remarks in one paper on the subject of workmen's compensation claim reserves are noteworthy: "It is of the highest importance that claim reserves be ample. The British makeshifts in this regard will not answer; much less will the makeshifts which we have been compelled to use in employers' liability insurance for want of anything better." While casualty managers in this country are aware of the pitfalls of American liability insurance, they will probably admit in the light of past experience that the description of their own methods of estimating for outstanding claims as makeshifts is not wholly undeserved. Yet in extenuation of past errors they may fairly claim that reserves in this country were made on the best estimates obtainable and with every intention that they should be adequate; and they may point to the fact, perhaps still to be discovered in America, that claims for workmen's compensation have a singular tendency to cost a great deal more to settle than appeared to be at all probable when they were first notified.

The papers contributed in the first four parts (constituting Volume I) of the *Transactions* include some useful actuarial formulas for estimating the values of death benefits payable to surviving dependants by way of annuities reckoned as a percentage of the wages of the deceased workman. These are, of course, an important part of the problem, but their usefulness is restricted to the assessment of the cost of claims actually notified. In the present stage of the

experience, perhaps the greatest difficulty is not to assess the cost of known claims, but to estimate the comparative frequency of accidents. Valuable work has been done in this direction by Dr. I. M. Rubinow, President of the Society and Chief Statistician in the United States to the *Ocean Accident and Guarantee* Corporation, who has constructed a standard table showing the relative distribution of 100,000 accidents. In his paper on Scientific Compensation Rates he condenses this table as follows:

Fatalities	932
Total permanent disability	133
Dismemberments	2,300
Other permanent partial disability	2,442
Total temporary cases	94,193
	<u>100,000</u>

A very little reflection will show that, when the problem of correctly assessing the rates of premium to be charged for compensation insurance has been solved, the problem of estimating for unsettled claims and unexpired liability will, at least in theory, have been solved also, although considerable difficulty may remain in applying the estimates in practice. But the point is that by common consent the pure premium to cover the cost of compensation is invariably reckoned as a percentage of the total wages paid, that being the most efficient measure of the exposure to risk. To this pure premium is added a loading to cover commission, expenses and profit. Hence, if the pure premium be adequate, all that is required is to set it aside as part of a fund composed of all the pure premiums out of which to pay the claims. If the actual experience is more favorable than that on which the pure premium is based, there will be a profit on the reserve; if it be less favorable, there will be a loss, but these fluctuations would be observed and a repetition of loss could be rectified by increasing the standard of reserve. Considerations of this kind have led to the fallacy of using a percentage of the premiums as the standard of reserve. The result, as already indicated, has been the application of a low percentage, based on a favorable experience resulting from high premiums, to a period when the premiums to which the percentage was applied had been reduced by unwise competition to a dangerously low level.

Some Problems for Solution.

In theory this method of setting aside a pure premium fund should provide also for the reserve for unexpired risk, but here is involved the assumption that the entire pay-roll upon which the premium is received is disclosed at the commencement of the risk and therefore that the entire premium is received when the contract of insurance is entered into. If that were the case the fund formed from the pure premiums would be sufficient to provide for all the

claims which might occur either before or after the end of any year of account, in respect of insurances effected during that year. But in practice a large portion of the premiums on workmen's compensation policies is not received until the end of the year of risk, or in many instances at the end of monthly intervals during the year of risk, and then only as a result of an audit of the wage-books of the insured conducted at the expense of the insurance company. Hence the practical application of the method of establishing, as a percentage of the pay-roll, a fund for claims and unexpired risk based on the pure cost of the risk assessed would involve the task of estimating, at the time each workmen's compensation policy was effected, the total amount of wages upon which to base the amount of the pure premium claim fund; and, in view of the extent to which wages are affected by trade activity or stagnation, a forecast of the kind would be a matter of considerable difficulty. The premium obtained when the policy is effected is sometimes only a deposit, quite insufficient to cover the risk for more than a short period, and at the end of any year of account large amounts may be due to the insurance company for risks already carried. Hence the difficulties in the way of assessing reserves, either as a percentage of pay-roll, or as a proportion of the premiums collected, are very great.

Nor is the problem of assessing the cost of claims actually reported in respect of disabling injuries much simpler. Injuries which on their first notification seem relatively slight may cause prolonged disablement, or the period of disability may be extended by malingering, and a great deal of experience must be accumulated and tabulated before reliable data are available for the purpose of estimating the cost of claims on the basis of an average. And any average thus obtained will require frequent correction to take account of the tendency of claims to cost more to settle as workpeople become acquainted with their rights under the law.

Again, the system of setting aside a fixed percentage of the premiums on risks current at the end of the year of account, to provide for unexpired risk, is by no means a scientific solution of the problem. It may leave the company with a large amount of undisclosed liability which is only provided for by the concealed asset of premiums due in respect of the excess of the true pay-roll over the preliminary estimate. Hence even the New York government standard of fifty per cent. of the premiums on current risks, while it might be an excessive provision if all the premiums were collected in advance, bears no real relation to the inability undertaken and still unsettled. The fact that the labors of the Society are much needed is obvious, and it is clear, too, that its members are in earnest in their determination to examine the difficulties thoroughly and dispose of them effectively. So far, their attention does not seem to have been directed to methods for computing unexpired liability.

The Society's proceedings include an interesting paper on the use of the Hollerith machine for tabulating workmen's compensation

statistics. Unquestionably, this machine is a great help in classifying large masses of detail, and when it prints the results of its tabulations—as we believe it will ultimately be made to do—it will be of even greater service than it is at present.

The paper in question (by Mr. E. E. Cammack) suggests valuing unearned premium reserves by direct computation, but we are inclined to think that, even if a Brunsviga or an arithmometer be used for the purpose, the calculation can be done with less work by means of a simple summation formula.

Some attention has been devoted to the subject of schedule rating, and interesting papers have been written and discussed. It is satisfactory to find that the members are fully aware of the practical obstacles to the application of a system of reducing premiums for risks where safety appliances are in use and increasing them where the equipment of the plant is under-average. A scientific system of merit-rating is admirable in theory. It has its counterpart in life assurance, where an impaired life is rated up and a total abstainer is charged a reduced rate. But life assurance, in spite of keen competition between rival offices, is conducted with less elasticity than casualty insurance, because the chance element in it is confined within narrower limits. And any practical casualty underwriter will admit that, while reductions in rates are claimed and granted on very slender justification, it is far from being an easy matter to get back on the bad risks what is given away on the good.

Examination Scheme.

These, however, are practical considerations which will receive due attention at the right time. The main point is that the Society is formed of men well known in American casualty insurance circles as pioneers in the investigation of points of difficulty. It proposes that its members shall be qualified by examination, and the syllabus of the examinations bears evidence of a broad grasp of what ought to be known and studied by them. The first two examination papers contain some searching questions on matters of eminently practical knowledge and would prove a useful test of the training of candidates for membership. The mathematical part of the syllabus includes advanced algebra, elementary differential and integral calculus, elementary calculus of finite differences, theory of probability and least squares; compound interest and annuities-certain; theory of, and practical problems in, statistics; and the elements of the theory of life annuities and assurances, including the calculation of premiums and reserves for the simpler forms of policy. Thus the fundamental training of an actuary is to be taken as the starting point of the requirements of the members. Thereto is added a knowledge of policy forms and underwriting practice in casualty insurance, including personal accident, health, liability, workmen's compensation, fidelity, surety, plate glass, steam boiler, burglary, fly wheel, auto-

mobile, workmen's collective and credit insurance. This is a very wide programme, but a very wise one also. There is much to be done in the way of pruning and regulating many of the miscellaneous branches of casualty insurance which have had their beginnings any time within the last sixty years, and of combining the tabulated experience of the companies transacting them. Personal accident insurance, for example, has been extended, elaborated and decorated with what are known in America as "frills" to an extent which would have amazed its original founders, without much real advantage to the companies or even, perhaps, to the public. And—although this is less a matter for scientific treatment than for the application of practical common sense to cutting out an abuse of competition—steps might well be taken to reduce the high rates of agents' commission which have been paid to procure this class of business.

Papers have already been presented to the Society on accident and health insurance and on burglary insurance statistics. The scientific treatment of the latter is perhaps one of the most interesting developments of latter-day insurance. Most of the principal forms of insurance—except, of course, those concerned with war risks—aim at indemnifying the insured against the consequences of some hazard of nature. Burglary insurance is a tacit recognition of the permanence of human villainy and of the fact that even this is subject to the law of average, and its inclusion in the purview of the Society is an evidence of sound sense. We congratulate the founders on their zeal and public spirit and tender our cordial wishes for the successful development of the usefulness of their undertaking.

Thomas Bradshaw has become the Commissioner of Finance and City Treasurer of Toronto, Canada.

Arne Fisher, formerly in the actuarial department of the Equitable Life Assurance Society, is now connected with the Prudential Insurance Company in its statistical department.

Theodore E. Gaty has been elected a vice-president of the Fidelity and Casualty Company. His new title is Vice-President-Secretary.

Frederick L. Hoffman's book, entitled "The Mortality from Cancer throughout the World," has been published by the Prudential Insurance Company. Copies may be obtained free upon application to the author, by libraries and students of the cancer problem.

Virgil M. Kime has been appointed actuary of the casualty department of the Travelers Insurance Company.

I. M. Rubinow has gone to California for six months to act as consulting actuary for the Social Insurance Commission of that state, appointed in 1915. The Commission has been delegated to make a study of all branches of social insurance, and will devote special attention to the preparation of a health insurance bill.

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

THE CASUALTY ACTUARIAL AND STATISTICAL SOCIETY OF AMERICA.

THE COUNCIL.

Officers: I. M. RUBINOW *President*
ALBERT H. MOWBRAY *Vice-President*
BENEDICT D. FLYNN *Vice-President*
CLAUDE E. SCATTERGOOD *Secretary-Treasurer*
RICHARD FONDILLER *Editor-Librarian*

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ALBERT W. WHITNEY October, 1916
HARWOOD E. RYAN October, 1917
JOSEPH H. WOODWARD October, 1917

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HARWOOD E. RYAN

W. N. MAGOUN

C. E. SCATTERGOOD

MEMBERSHIP OF THE SOCIETY, MAY 26, 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, Office of Miles M. Dawson, Consulting Actuary, 141 Broadway, New York.
Oct. 22, 1915	Brown, Herbert D., Chief of 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.
- † 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, A. H., National Workmen's Compensation Service Bureau, 13 Park Row, 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., 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, 133 William St., New York.
- † Downey, E. H., Special Deputy Insurance Commissioner, 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., 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, 133 William St., New York.
May 26, 1916		Frankel, Lee K., Sixth 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., Superintendent, Burglary and Plate Glass Department, Travelers Indemnity Co., Hartford, Conn.
	†	Gaty, Theodore E., Vice-President-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., Statistician, Travelers Ins. Co., Hartford, Conn.
	†	Gould, William H., Secretary-Actuary, Jos. Froggatt & Co., 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 & 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., Secretary, Accident Prevention Department, National Workmen's Compensation Service Bureau, 13 Park Row, New York.
- Oct. 22, 1915 Hatch, Leonard W., Chief Statistician, State Industrial Commission, Albany, N. Y.
- Oct. 22, 1915 Hess, Herbert, Statistician, Massachusetts Bonding & Ins. Co., Boston, Mass.
- † 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., General Manager, Massachusetts Rating and Inspection Bureau, Boston, Mass.
- † 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 & 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., 343 Broadway, New York.
- Feb. 25, 1916 Jackson, Charles W., Actuary, Postal Life Ins. Co., 35 Nassau St., 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., 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, 425 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 Mayercrink, Emma C., New York Ins. Dept., 165 Broadway, New York.
- Feb. 19, 1915 Mead, Franklin B., Secretary & Actuary, Lincoln National Life Ins. Co., Fort Wayne, Ind.
- Oct. 22, 1915 Meeker, Royal, Commissioner, Bureau of Labor Statistics, U. S. Dept. of Labor, Washington, D. C.
- † Michelbacher, G. F., Statistician, 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, J. F., Secretary, Maryland Casualty Co., Baltimore, Md.
- † 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., Actuary, National Workmen's Compensation Service Bureau, 13 Park Row, New York.
- † Pally, 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 & 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-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.

Date Enrolled	
Oct. 22, 1915	Baxter, Don. A., Assistant Deputy Ins. Commissioner, Michigan Ins. Dept., Lansing, Mich.
Oct. 22, 1915	Brann, Ralph M., Assistant Manager, State Compensation Ins. Fund, Denver, Col.
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. 22, 1915 McGuire, Vincent G., State Industrial Commission, 230 Fifth Ave., New York.
- Oct. 22, 1915 Müller, Fritz, New York Life Ins. Co., 346 Broadway, New York.
- Oct. 22, 1915 Tilson, Howard, Manager, Illinois Division, Accident Prevention Dept., Workmen's Compensation Service Bureau, Insurance Exchange, Chicago, Ill.
- Oct. 22, 1915 Van Tuyl, Hiram O., Assistant Examiner, New York Ins. Dept., 165 Broadway, New York.
- 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.

DECEASED FELLOWS.

Date of Death

- Aug. 20, 1915 Montgomery, William J., State Actuary, Boston, Mass. (Admitted Feb. 19, 1915)
- July 24, 1915 Phelps, Edward B., Editor, The American Underwriter, New York. (Charter Member)

SCHEDULE OF MEMBERSHIP, MAY 26, 1916.

	Fellows.	Associates.	Total.
Membership, February 25, 1916.....	135	13	148
Addition:			
By Election—May 26, 1916.....	4	—	4
Membership, May 26, 1916.....	139	13	152

**ABSTRACT FROM THE MINUTES OF THE MEETING,
MAY 26 AND 27, 1916.**

The sixth regular meeting of the Casualty Actuarial and Statistical Society of America was held in the Assembly Hall of the Travelers Insurance Company, Hartford, Connecticut, on May 26 and 27, 1916.

President Rubinow called the meeting to order at 10 A.M. The roll was called, showing the following thirty-one Fellows and three Associates present:

FELLOWS.

BLACK	FONDILLER	MOORE, G. D.
BUCK	GARRISON	MORRIS
BUDLONG	GOODWIN	RUBINOW
CAMMACK	HAMMOND	RYAN
CRAIG, A. H.	HESS	SCATTERGOOD
CRAIG, J. D.	HODGKINS	SENIOR
DUBLIN	HUGHES	SULLIVAN
FALLOW	HUNT	WHITNEY
FARRER	KIME	WOODWARD
FISHER	LAIRD	
FLYNN	MADRILL	

ASSOCIATES.

BROCKWAY	LEVY	WILLIAMSON
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The President delivered an address upon "The Relation between Private and Social Insurance," printed in this number.

The minutes of the meeting held February 25, 1916, were approved as printed in the *Proceedings*.

The Council reported affirmative action as follows:

That the requirement that candidates for Associate membership take Parts I and II of the Syllabus be suspended until but not including the examinations to be held in May, 1918.

That the names of candidates who shall be successful in passing the Society's examinations shall be enrolled as members, as of the next meeting of the Society after the examination results are announced.

It was moved and carried that the report of the Council be adopted by the Society.

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:

Bucklin, Walter S., President, Massachusetts Employees Ins. Assn., 185 Devonshire St., Boston, Mass.

Crum, Frederick S., Assistant Statistician, Prudential Ins. Co., Newark, N. J.

Frankel, Lee K., Sixth Vice-President, Metropolitan Life Ins. Co., 1 Madison Ave., New York.

Parker, Jr., John M., Secretary, Accident and Liability Department, Aetna Life Ins. Co., Hartford, Conn.

After ballot, these nominees were declared duly elected Fellows.

The reports of the Treasurer and the Editor were read and accepted. The report of the Committee on Examinations, which was submitted by its chairman and accepted, stated that the committee had prepared and published a pamphlet of recommendations for study in connection with the Society's examinations.

The following amendment to the Constitution, proposed and approved by the Council, was brought in due and regular form before the Society so that action concerning it might be taken by the Society at its next annual meeting in October, 1916.

Present matter proposed to be eliminated is in parentheses; new matter is underlined.

CONSTITUTION

Article IV.—Officers and Council. The officers of the Society shall be a President, two Vice-Presidents, a Secretary-Treasurer (and), an Editor (-Librarian), and a Librarian.

BY-LAWS.

Article III.—Duties of Officers.

Fourth paragraph. The Editor (-Librarian) 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.

Fifth paragraph. The (Editor-) Librarian shall, (also) 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 papers printed in this number were read or presented.

The Society adjourned for recess at 1 P.M.

Luncheon was served at the Hartford Golf Club.

The Society reconvened on May 27, 1916, at 9.30 A.M.

The reading and presentation of papers was resumed and the papers read at this meeting and the October, 1915, meeting were discussed.

A vote of thanks was given to the Hartford members for the hospitality extended to the Society and to the Travelers Insurance Company for the use of its assembly hall.

Upon motion, the meeting adjourned at 1 P.M.

CONSTITUTION.

ADOPTED FEBRUARY 19, 1915.

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, and an Editor-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.

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-Librarian 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 Editor-Librarian shall also, 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.

EXAMINATIONS OF THE SOCIETY.

COMMITTEE ON EXAMINATIONS.

GEORGE D. MOORE (CHAIRMAN)

LOUIS I. DUBLIN

GUSTAV F. MICHELbacher

CHARLES S. FORBES

HARWOOD E. RYAN

EXAMINATION FOR ENROLLMENT AS ASSOCIATE.

HELD ON MAY 3, 1916.

PART III. FIRST PAPER.

Time Allowed, Three Hours.

Select any six of the following questions:

1. (a) Two notes—one of face value \$200.00, due in one year, the other of face value \$300.00, due in two years, are purchased for \$450.00. What effective rate of interest is realized?

(b) Prove and interpret verbally the following formula:
 $1 = i \overline{a}_{\overline{n}|} + v^n$.

(c) State symbolically the difference between discount at simple interest, discount at compound interest and commercial discount.

2. (a) Explain the "marginal utility" theory of value.

(b) Define real wages.

3. What are the chief characteristics and uses of the coefficient of dispersion?

4. (a) If v, v^2, v^3, \dots , represent the values of 1 due 1, 2, 3, \dots , years in the future and $l_x, l_{x+1}, l_{x+2}, \dots$, the number of persons who have attained the exact ages $x, x+1, x+2, \dots$, find the present value of a series of payments of 1 payable at the end of each year completed by a person now aged x .

(b) Express the result in commutation symbols.

5. Explain the advantage of the following type expressions:

Arithmetic average,

Mode,

Median.

6. A mine is purchased for \$10,000; at the end of the first year \$5,000 is spent for improvements; at the end of the second year \$4,000; at the end of the third year \$2,000; the mine has now been placed on an earning basis and begins to yield \$5,000 a year in perpetuity at the beginning of the fourth year. What is its capitalized value on the basis of a 10 per cent. effective rate of interest?

7. (a) The premium for a three year steam boiler policy payable in one sum, amounts to \$300. What loading should be applied, assuming 5 per cent. interest, if the premium is payable in three equal annual installments, and what loading should be applied, assuming 5 per cent. interest, if the premium is payable in three annual installments of 50 per cent., 30 per cent. and 20 per cent. respectively.

(b) Define force of interest and prove that force of interest equals force of discount.

PART III. SECOND PAPER.

Time Allowed, Three Hours.

Select any six of the following questions:

8. (a) How long will it take money to treble itself at 5 per cent. effective interest?

$$\begin{aligned} \text{Given } \log (1.05) &= .02119 \\ \log 3 &= .47712 \end{aligned}$$

(b) Prove that discount is interest payable in advance.

9. Assume that there are 100 men who desire to buy for their families the right to receive \$500, at the end of the year in which they die; that all the men are now aged 30; that the limit of life for the group is age 33; that 20 will die in the first, 30 in the second and 50 in the third year. What must each man pay for this right on the assumption that a 2 per cent. effective rate of interest can be earned?

10. What do you understand by the following terms:

- (a) Malthusianism,
- (b) Standard of living,
- (c) Single tax.

11. (a) What determines the rent of a given property?

(b) Define commercial paper.

12. (a) How would you explain the necessity for reserves under ordinary life insurance policies to a person who knows nothing about life insurance?

(b) What is a mortality table?

(c) Define an "Expectation of Life."

13. Define "coefficient of correlation" and "probable error." What use would you make of the "probable error" in the interpretation of a "coefficient of correlation?"

14. (a) A claim under a workmen's compensation policy is payable in weekly installments of "X" dollars for 300 weeks. Derive a formula to obtain the present value, assuming 6 per cent. effective rate of interest.

(b) When the nominal rate of interest is 4 per cent., what is the effective rate when convertible quarterly?

HELD ON MAY 4, 1916.

PART IV. FIRST PAPER.
Time Allowed, Three Hours.

Select any five of the following questions:

1. Illustrate the following table graphically.

Death rates from typhoid fever per 100,000 living. Cities and rural parts of registration states compared.

Year.	Rates per 100,000.	
	Cities.	Rural.
1900	28.5	34.6
1901	26.4	28.8
1902	25.8	26.9
1903	24.6	24.6
1904	24.0	23.7
1905	22.0	23.1
1906	33.4	27.8
1907	30.8	25.1
1908	23.5	23.2
1909	19.4	20.9
1910	22.4	23.3
1911	18.6	22.2
1912	15.5	17.0
1913	16.1	19.6

2. (a) In a recent study of workmen's compensation rates, it was determined that the percentage of expense loading should vary as between New York and Pennsylvania. Give reasons to justify such a distinction and show how you would proceed to establish the expense loading required for New York business.

(b) What information is contained in the manual of rates employed in liability and workmen's compensation underwriting?

(c) By what procedure is such a manual constructed?

3. (a) Describe briefly the law regulating the unearned premium reserve.

(b) State how this law is applied in practice. Do you consider the law fair? Give reasons for or against.

(c) Should the reserve be based upon gross premiums or otherwise and where should it appear in the annual statement?

4. (a) Name four states which require standard provisions in accident and health insurance policies.

(b) Give the substance of three such standard provisions.

(c) Specify one form of personal accident policy which is not subject to the requirement of standard provisions.

5. (a) A company is asked to issue personal accident insurance involving \$100,000 death benefit with double indemnity under specified conditions, upon a risk aged 40, occupation given as "stock broker." Inspection report states that applicant is known to be a moderate drinker, married and of fair reputation in meeting financial obligations. As the underwriter of the company, it is your duty to pass upon the risk. What recommendation would you make as to its acceptance? Give reasons.

(b) What are the essential features of the following kinds of insurance:

(i) Steam-boiler,

(ii) Automobile Liability,

(iii) General Liability.

(c) Draw up a brief form of schedule to be used for compiling statistical information as a basis for automobile liability rates. What method of classification of risks should be followed?

6. (a) What justification exists for compulsory insurance under a workmen's compensation law?

(b) What methods are open to an employer for the insurance of his workmen's compensation obligation in each of the following states:

(i) New York,

(ii) Pennsylvania,

(iii) Massachusetts,

(iv) Michigan,

(v) Ohio,

(vi) California.

(c) Contrast the principal advantages and disadvantages of mutual and stock insurance under a workmen's compensation law.

PART IV. SECOND PAPER.

Time Allowed, Three Hours.

Select any five of the following questions:

7. Examine and interpret the following table:
Percentage of given class of population living in urban communities.

Area and Census Year.	Per Cent. Living in Urban Communities.					
	Total Popula- tion.	White.	Negro.	Native White.		Foreign- born White.
				Native Parentage.	Foreign or Mixed Parentage.	
United States:						
1910.....	46.3	48.7	27.4	36.1	65.3	72.2
1890.....	36.1	38.4	19.8	26.2	56.6	61.8
Difference...	10.2	10.3	7.6	9.9	8.7	10.4

8. Describe the functions of one of the following statistical offices of the federal or state governments:

- (a) United States Bureau of the Census,
- (b) United States Bureau of Labor Statistics,
- (c) Any State Bureau of Labor Statistics.

Discuss the characteristics of the chief publication of the office with which you are most familiar.

9. Give parts of income and outgo statement of a casualty company. Construct the statement.

10. Describe briefly Schedule "Z"—Massachusetts; its form, its meaning, its purpose. Do you consider that the form is the best practical one to accomplish the purpose? Give reasons.

11. (a) Explain the objects of the cancellation provisions which are found in policies of fire and casualty insurance.

(b) Draft a form of cancellation clause which would be applicable to a policy insuring against liability for personal injury to an employee of the assured.

(c) What changes in underwriting practice would be necessary in order to issue health insurance policies without the cancellation provision? Give reasons.

12. (a) Name two states which supervise workmen's compensation insurance rates as to adequacy.

(b) What reasons can you advance for this form of state supervision?

(c) Describe another form of rate regulation by state government and explain its purpose.

(d) Certain states prohibit insurance companies from combining to fix rates. State whether, in your opinion, such legislation is beneficial to the public or otherwise and give reasons for your conclusion.

EXAMINATION FOR ADMISSION AS FELLOW.

HELD ON MAY 3, 1916.

PART I. FIRST PAPER.

Time Allowed, Three Hours.

Select any five of the following questions:

1. Assuming that all the experience used as the basis for compensation rates has been gathered in one state under a uniform act in three years; that the total payroll exposure for the three successive years is divided as follows:

Year.	Payroll Exposure.
1	\$20,000,000
2	35,000,000
3	45,000,000
	<u>\$100,000,000</u>

And that the experience exhibits in general the trend indicated by the following table of values for measuring the increasing cost of compensation:

Year.	Increasing Cost Factor.
1	100
2	110
3	115
4	118
5	120

What method would you suggest, using the available experience in deriving the pure premiums to produce rates to be used in the fifth year provided there is no change in the compensation act.

2. (a) What general considerations govern the investments of insurance corporations and how do these differ as between a company which writes principally accident insurance on the monthly premium plan and one which writes liability and surety business?

(b) A company is about to be organized with \$750,000 capital and \$250,000 surplus, to do a general casualty business. Assuming financial conditions of the present time, show how you would distribute the company's funds among the following classes of investments:

- (i) Real estate,
- (ii) Cash in banks,
- (iii) United States Government Bonds,
- (iv) Municipal bonds,

- (v) Railway bonds,
- (vi) Telephone bonds,
- (vii) Mortgages on real estate,
- (viii) Stock in other insurance companies,
- (ix) Manufacturing stocks,
- (x) Bank stocks,
- (xi) Railway stocks.

Give reasons for your conclusions.

(c) Select from the following list four (4) securities which you would regard as the best choice for a mutual company transacting the business of liability and workmen's compensation insurance.

- (i) Cleveland Ohio funded debt—1924 4s,
- (ii) Pennsylvania Railroad stock,
- (iii) American Telegraph & Telephone stock,
- (iv) U. S. Steel Common,
- (v) Willys-Overland,
- (vi) New York Highway Improvement 4s—March 1, 1958,
- (vii) Missouri, Kansas & Texas Railway 1st 4s—1990,
- (viii) Brooklyn Rapid Transit 5s—1918.

3. (a) Define the following terms:

- (i) Liquid assets,
- (ii) Amortization,
- (iii) Mortgage,
- (iv) Collateral,
- (v) Call money,
- (vi) New York City 4s—1955.

(b) What is meant by "Assets not admitted" in the annual statement blank used by insurance companies?

(c) Name two assets of this nature and state why they are so treated.

4. Discuss the theory of computing outstanding estimates for deferred losses under compensation death claims. Illustrate the essential differences in the problem presented by the New York and New Jersey Acts.

5. Discuss the desirability of standard policy forms. Name two standard policy forms now in use; their essential features, and any criticisms which you have with regard to the forms.

6. It is proposed to issue workmen's compensation policies with a deductible average clause providing: "In consideration of a reduced rate the assured agrees to pay the first \$50 of each loss incurred during the term of this policy."

(a) How would you determine the amount of reduction to which the rate would be subject?

(b) What effect would you expect such a form of policy to have upon accident prevention work on the part of the assured?

(c) What general criticism can you offer of such a plan?

PART I. SECOND PAPER.

Time Allowed, Three Hours.

Select any five of the following questions:

7. (a) Explain the uniform rule prescribed by law in several states for computing liability loss reserves. Make your answer applicable to a company which has been doing this class of business for twenty (20) years.

(b) Is this rule properly applicable to workmen's compensation insurance? Explain your answer.

(c) Formulate a rule for computing loss reserves under workmen's compensation insurance policies which would apply with equal justice to a stock company charging low non-participating rates and a mutual company charging high participating rates.

8. (a) Assuming that personal judgment must be used to supplement statistical data, what service, if any, can the following professions offer in the establishment of rates for workmen's compensation insurance:

- (1) Actuarial,
- (2) Statistical,
- (3) Underwriting,
- (4) Safety Engineering.

(b) Justify by general reasoning the practice of charging different rates for public liability and property damage coverage for private pleasure automobiles as between the following territories:

- (1) Greater New York,
- (2) New England States,
- (3) Middle Western States.

9. Discuss control of medical expense under Compensation Acts. Criticize and compare the medical features of two Compensation Acts. What organization do you suggest to handle this problem?

10. Discuss briefly the essential differences in adjustment of personal accident losses and of liability losses.

11. (a) Distinguish sharply between the type of investments which should prevail in the case of a life insurance company and of a company transacting the following lines of insurance: personal accident, burglary, plate glass and steam-boiler.

(b) A law is proposed which would require that all stocks held by life insurance companies must be disposed of within five (5) years. What, in your opinion, would be the effect of such a measure upon a company which owns a large block of high-grade stocks?

(c) State briefly the substance of a letter which might be written to a member of the legislature expressing your views with respect to the measure outlined in (b).

12. Discuss briefly the respective merits of company inspections versus central board inspections—versus state board inspections.

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STATISTICS NECESSARY FOR COMPUTING NET COMPENSATION RATES. Edward Olifiers.

THE COMPENSATION COST OF OCCUPATIONAL DISEASE. James D. Maddrill.

WORK OF THE STATISTICAL COMMITTEE OF THE BUREAU OF PERSONAL ACCIDENT AND HEALTH UNDERWRITERS. Benedict D. Flynn.

AMERICAN METHODS OF COMPENSATING PERMANENT PARTIAL DISABILITIES. I. M. Rubinow.

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