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

ESSENTIALS OF FAMILY STATISTICS—EDWIN W. KOPF.

VOL. V, PAGE 64.

WRITTEN DISCUSSION.

MR. L. W. HATCH:

One of the encouraging signs of progress in the field of statistics of late is the increasing number of studies of sources and methods for particular subjects, as distinguished from treatises on statistical sources and methods in general. Progress toward more adequate statistical material, better methods of handling it, and more effective presentation of results, is bound to be aided, and is in the long run largely dependent upon such specialized studies. As an example of such a study, Mr. Kopf's paper on the Essentials of Family Statistics is, therefore, to be welcomed. Furthermore, this paper has additional interest from the fact set forth in a footnote to the title that the paper is an excerpt from a manual which the author has in preparation on Essentials of Social Statistics, a title of sufficiently broad implication to indicate a very ambitious undertaking, involving, it would seem, a whole series of studies of individual subjects like this one of family statistics which is before us.

I shall put my comments on Mr. Kopf's paper under two heads, first, as to substance, and second, as to manner of presentation.

As to substance, the paper is mainly an enumeration and critical description of classes, sources and arrangement of statistical data relating to the family. For such a presentation in a statistical "manual," a prime quality to be expected is fullness of treatment. On this score I have only favorable comment to offer here. One cannot fail to be impressed by the extent and detail of knowledge of the subject which the author displays, knowledge based evidently on both original study of his subject and acquaintance with literature concerning it. I must confess that my own knowledge of the field has not been sufficient, nor have I had time to make critical investigation for the purpose of this discussion, to enable me to judge the matter fully, but to the best of my judgment, Mr. Kopf's presentation is exhaustive.

In two aspects, however, the substance of Mr. Kopf's paper does not impress me so favorably. One of these has to do with those

portions of the paper which present fundamental analyses of subjects as bases for classifications of material. Here there is occasionally evidence of loose generalization, and obscure statement. Of several examples of what I refer to which might be cited, only one is here noted. On p. 65 is the statement without supporting evidence or reasoning, that "No other social units (besides the family) would be possible without the basic social unit of the family." If this means that all other social units are built up upon family units, it is a generalization which is not true. There is one sense in which it is true, namely in the sense that the family is the means of reproducing individuals, so that without it there would be no individuals to form social units. If that is the idea intended, it is obscurely and ambiguously expressed, in addition to being a truism hardly worth stating.

A second criticism of the substance of Mr. Kopf's paper which I am moved to make has to do with a number of statements concerning the significance of the different kinds of family statistics for the actuary and insurance statistician. These are for the most part so brief and have so much the character of mere addenda at the close of discussion of the various topics as to weaken their force. In view of Mr. Kopf's announcement that his Manual of Social Statistics is designed for use of persons intending to become associates of the Casualty Actuarial and Statistical Society, this is particularly unfortunate. It would seem as though for that purpose greater pains and space should have been devoted throughout his paper to this aspect of his material.

Turning from substance to manner of presentation, it must be said that Mr. Kopf's paper is open to really serious criticism. Without the least inclination to be captious, and solely with a desire to be helpful, I feel that I must speak rather frankly. To put the matter in a word, the paper suffers not a little from inaccurate and incorrect use of words, clumsy sentence construction, and obscure language. Here are some examples of such defects.

On p. 68 is the expression "Auxiliary statistical facts on marriage . . . are at present anticipations," which a more accurate use of words would render, "Auxiliary statistical *data* on marriage . . . *can only be anticipated* at present."

On p. 65 it is said "Through it (the family) the individual is brought from a *disintegrated* state into elementary ethical relations," in which "disintegrated" is incorrectly used for "isolated."

On p. 70 is this sentence: "It is hoped that they will meet the social statisticians fraternally by giving the proposal the most serious consideration, thus to show their appreciation of one of our vital needs," the last clause of which is of most clumsy (if not quite incorrect) construction, the obvious remedy being to change the words "thus to show" to "and thus show."

On p. 71 following and in explanation of the statement that "the sacrifices and hardships entailed by marriage and the obliga-

tions of family are a powerful cultural and selective force" is this sentence: "They insure the persistence of ethical characters in rugged individuals who take upon themselves this primary form of human association, and virtually guarantee the elimination from the race stream of some of the ethically unfit, by means of the 'defense reaction' of individual selfishness engendered in the latter individuals by the prospect of sacrifice." It certainly requires more than one reading to free the meaning of the latter part of that sentence from obscurity.

These shortcomings of language may perhaps be regarded by some as not of major importance. Nevertheless, of all the sciences, statistics should aim at the highest standards of clear and accurate expression, and to maintain such should be a constant endeavor of our Society. Both for this reason, and because I regret to see so rich material as Mr. Kopf's paper contains, marred in the presentation, I have been impelled to inject some literary criticism into this discussion.

MR. GEORGE B. BUCK:

Mr. Kopf's paper, while of particular interest to the social statistician and developed largely from his viewpoint, presents a subject which I believe will demand of the actuary increasing attention in the future. The need for adequate social statistics in this country is especially appreciated by those actuaries who are at present confronted with the necessity of adapting for use the meagre data of this kind that are available, in an endeavor to meet in some practical fashion the requirements imposed by certain existing social legislation.

When consideration is given to the probable future development of various forms of social insurance, the value of laying a sound foundation for the compilation of required data as outlined by Mr. Kopf becomes doubly apparent. Such statistics will, undoubtedly, afford a basis for testing the actual operation of considerable social legislation and for prognosticating its future development. As a result, more careful and scientific work in the preparation of such legislation will be possible and a considerable amount of experimenting in this field, which is now necessary may be avoided.

Mr. Kopf presents a very careful and scholarly exposition of the scope and requirements of this field of statistics. I feel that there is little that I can add, unless it be from that point of view with which I am most familiar, that is, from the point of view of the actuary of an employee's benefit or pension fund. Mr. Kopf refers to the fact that family statistics are fundamental to the practice of compensation insurance. They are similarly fundamental to the scientific operation of the majority of pension and benefit funds.

The public expects every policemen's and firemen's pension fund

to provide pensions for widows and orphans. Public employees in other occupations, involving similar or extra hazards expect to be covered by like benefits. These benefits many times cover, not only payments on account of accident, similar to compensation benefits, but supplementary benefits on account of disability or death through other causes. Many of the large industrial funds offer as complicated a system of benefits. To make valuations of these funds, the probabilities of marriage and remarriage, the probability of issue, the number and ages of children within family groups, related to ages of mother and father should all be available.

A wealth of information on this subject in this country would now be accumulating, had such funds been operating scientifically. Unfortunately, however, the usual procedure in the history of these funds has been not to make actuarial valuations of cost, and therefore no need for recording basic statistics has been felt. In the future, as more scientific methods of operation are adopted, both the municipal and industrial fund are going to furnish valuable sources for these data. The statistics of the Scottish Widow's Fund as prepared by Mr. Hewat, are a notable example of the valuable data along these lines, which might be available through the proper operation of the benefit fund.

At the time of the valuation of the New York City pension funds in 1914–1916, no general data could be found upon which to predicate a valuation of a fund providing pensions to children who might be left by an employee dying in service. The United States census compilations presented no data such as are suggested by Mr. Kopf to furnish a basis for work of this character. The data which could be obtained in relation to workmen's compensation did not cover the problem. The only data available which would furnish a basis for such a valuation were those collected in connection with European benefit funds. Fortunately, the New York Service was of a size to justify the preparation of a complete set of tables to use as a basis for deriving the various probabilities needed in the valuation of benefits to the families of employees. In connection with the reorganization of the New York City funds, an adequate system of recording data will be installed and these tables will be added to and corrected as the experience develops.

I note that Mr. Kopf states that he will discuss the analytic processes and the graduating and testing of data in an additional and later paper. I hope he will also give us an indication of the general form of the tabulations of data which he believes should be made. Such a discussion will be of great value because the processes employed become somewhat intricate if we are to obtain results such as Mr. Kopf recommends. The practical use of the data after being obtained is somewhat complex and tedious. I know of cases, where, after obtaining the major part of the data required for use, the calculator has abandoned his basis in favor of some arbitrary assumption which would facilitate his calculations,

either because of the lack of time or because he is not familiar with the procedure that might have been followed.

The desire to follow the path of least resistance, or unfamiliarity with processes of tabulations and calculations often causes those not primarily concerned with the use of data, to discard certain valuable collections as a by-product. I mention "by-product" in the sense of data of possible future value for which there is no immediate need, which is collected along with other information actually required, with the idea in mind that its collection does not involve any additional expense, and yet may make available for future tabulations and use, data which might otherwise be lost.

I believe that the work that Mr. Kopf is accomplishing through this paper and the one proposed will be valuable to both the student and actuary who may undertake statistical work of this character.

MR. BRUCE D. MUDGETT:

Mr. Kopf's paper on "Essentials of Family Statistics" is planned as part of a manual on social statistics for the use of students preparing for the examination of the society. The scattered and fragmentary character of the statistical materials which are needed for these examinations has made imperative the preparation of such a manual if students from widely separated parts of the country are to have access to the facts. The paper will be considered in the light of its fulfillment of this purpose.

Such a manual, or textbook, should first attempt to give the student a broad general view of the field, and should then deal with specific details with reference only to their relationship to, or bearing upon, the larger aspects of the subject. It should, in short, present a fundamental theory as a basis for the study of particular statistical practice.

The principle here stated has been adhered to in Mr. Kopf's paper, which deals with social statistics of the family. The discussion is devoted mainly to three phases of the subject, family formation, family disintegration, family functioning. It presents under the three subdivisions the sources of materials; statistical particulars available and needed; and tabulations and ratios used to throw each problem into relief and does not confine itself to data of value solely to the insurance actuary or statistician. The references to fuller discussions by other authors are valuable in a paper of this character.

Considering the paper from the standpoint of the student, its compactness, though necessitated by its brevity, may offer a difficulty, in that the particular problems in which the student is most interested, especially the insurance problems, are not discussed at sufficient length. Possibly the fuller discussion might be made a part of the present paper, possibly continued in another and more advanced textbook. The following is an illustration: birth sta-

tistics are stated to be valuable to the insurance statistician for computing the "exposed to risk," or population, at ages under five years for the construction of life tables. For the prospective actuary who is not already working in an insurance office and on just such a problem, the presentation will be inadequate, and to familiarize himself with this use of birth statistics the examinee must go to other sources. This he will in many cases be unable to do. Students who have this preliminary knowledge of the method of constructing a life table will be much less troubled by the mazes of actuarial formulæ with which he meets in the actuary's office.

This statement is intended less as a criticism of the present paper than as a plea that the further work be done and that the methods of utilizing such statistics in insurance offices be made more generally available. The present paper is a scholarly piece of work and has made the proper approach to the subject.

MR. EDWIN W. KOPF:

(AUTHOR'S REVIEW OF DISCUSSION.)

There is evidently need for a manual on the statistical foundations of casualty and social insurance science. The older schools of statistics and actuarial science dealing with life contingencies, had need for little more than the facts of human aggregation. Their interest was confined largely to two facts,—the first, that an individual was simply a member of a group regardless of whether that individual bore any social relation to any other member or not; the second fact was the contingency of individuals leaving the group by death. And so, there has been, until recently, no need for a statistical and actuarial science concerned with more than the mere fact of aggregation,—grouping.

The issues as to social policy and programme raised in casualty and social insurance, however, deal with more than the elementary fact of grouping or aggregation. The emphasis is placed upon the kind and extent of *association* of individuals within a group and the effect of certain insurable incidents upon such associations. Many social mishaps destroy association between individuals and produce compensable losses, but the persons affected still stay within a demographic group. The casualty and social statistician, therefore, requires not only the data on human *aggregation,* but also the facts of *association* among men for purposes of growth, advancement, reproduction, defense, and force. We must be careful to note that a fact is not a *social* fact unless both aggregation *and* association are demonstrated. A social statistics suitable for the casualty and social insurance student must, therefore, deal with the several social units,—their enumeration and description in order of genetic importance of the several elementary forms of association within the "aggregates" of the older statistics. It must define and describe the various social structures, their

makeup, functioning, pathology and treatment. A simple nomenclature, borrowed from the best elements of the newer sociology, will have to be agreed upon. This social statistics will then become the research tool of the inductive sociologist, the statistician in the insurance sciences, and the legislator. In a manual thus devoted to bringing the statistics of casualty and social insurance closer to modern sociology, more space must be given to discussion of such a subject as statistics of the family than has been possible in this short article. It will be required, also, to go into greater detail of explanation of such points as the use of birth statistics (data of one phase of family function) in the compilation of life tables. The statistical needs of specialists in pension, sickness, invalidity, maternity insurance and other subjects in our field must also be considered in the required detail. Our mathematical friends will find ample opportunity for employment of their special gifts. The theory of multiple skew correlation, for instance, awaits only a supply of social data and the properly qualified man.

We may hope soon to get rid of the Spencerian mechanical view of society and of some of its misstated and misunderstood problems, when we add to our notion of Society as a structure of aggregates, the more advanced idea that Society also comprehends the causes, forms and results of the associations of individuals. Dr. Hatch mentions a fault in the manner of presenting the argument for family statistics. More attention should be paid, as Dr. Hatch has indicated, to the clearness, ease, elegance and force of the language we use in our printed papers. There is no reason why language should be used, as in several sentences of my paper, to conceal and confound thought. The defect could have been easily remedied.

MORTALITY FROM EXTERNAL CAUSES AMONG INDUSTRIAL POLICY-HOLDERS OF THE METROPOLITAN LIFE INSURANCE COMPANY, 1911–1916—LOUIS I. DUBLIN.

VOL. V, PAGE 10.

WRITTEN DISCUSSION.

MR. ALBERT H. MOWBRAY:

This paper is such a mine of information that it is hardly possible within the limits of any reasonably brief discussion to more than scratch the surface. I am bringing to the attention of the society certain points which struck me quite forcibly in my first reading of the paper, although each subsequent perusal brings out new points of interest, and it would seem well worth while for each member to carefully study the voluminous data Dr. Dublin has laid before us.

Dr. Dublin was good enough to present to us at our meeting in February, 1916, a paper with a similar title, in which the experience was traced from 1911 to 1914, and in certain respects it is interesting to compare the material in the present paper with that presented at the earlier meeting, noting the developments of the two added years. For example, at that time the total number of deaths studied was 32,057. The two additional years have added 18,655 deaths, but the death rate per 100,000 exposed has remained almost identical, that for the period from 1911 to 1914 being 94.4 per 100,000 and for the full period, 94.3. In the full period, however, were included 1,149 war deaths, at the rate of 2.1 per 100,000 exposed, so that the non-war deaths for the entire period would appear to be 92.2. This would indicate that the rate for the two additional years was somewhat below that for the earlier period. The rate per 100,000 for suicides also seems to have declined, since the rate for the entire period is 12.2 and the rate for the first three years was 12.9. On the other hand, the homicide rate of 7.0 appears to have remained constant.

Dr. Dublin makes comparisons between the accidental (including unspecified violence) death rates for the United States and for England and Wales, and it must be admitted that the comparison is not at all favorable to the United States. We might further extend the comparison by bringing in the figures from the Twenty-fourth Report of the United States Bureau of Labor, quoted from the investigation covering the years from 1887–1905 of the Leipzig Communal Sick Fund. This investigation covered 1,284,576 exposure years, during which 528 deaths from external

causes were recorded, at the rate of 41.1 per 100,000. Of course, the period from 1887–1905 was probably a period of less high pressure than the present time, but, at any rate, it appears the slower-going German city of Leipzig at that time was a much safer place, from the standpoint of accidental death, than either the British Isles or the United States of America now. Of course, we have no basis of comparison as of the present day.

To one who has given considerable attention to the graduation of mortality tables, Table II is decidedly interesting, and in some respects almost startling.

Makeham's law, which has been found to fit remarkably well many compilations of life insurance mortality experience, appears to confirm the reasoning of the late Benjamin Gompertz:

"It is possible that death may be the consequence of two generally co-existing causes; the one, chance, without previous disposition to death or deterioration; the other, deterioration, or increased inability to withstand destruction."

Most of us have doubtless been inclined to look upon the chance element, the one that remains constant regardless of age, as the chance of death due to external cause; yet Table I shows an increase with age almost, if not quite, as rapid as is the increase in the death rate from all causes. On further consideration, however, Makeham's hypothesis does not necessarily appear in conflict with this fact, since there are certain external causes which often ultimately result in death which do not necessarily result in death, but whose fatal consequences are dependent upon a lack of resistance in the individual victim almost, if not quite, as much so as with disease.

It would seem that the indications of this table would be nearly as startling to the student of personal accident insurance, since, generally speaking, it is not customary to differentiate the rates according to the age of the insured. If the probability of death from external violence is a factor which increases rapidly with age, is it not likely that disability due to external violence may be equally, if not more, a factor which increases with the age of the insured?

Tables III and IV, dealing with the relative mortality from accident and unspecified violence according to sex and color, are also very interesting, and, when all factors of life conditions are taken into account, the results do not seem unreasonable, notwithstanding apparent peculiarities upon their face.

A comparison of the mortality rates in Table VI with those in Table I of the earlier paper, PROCEEDINGS, Vol. II, p. 188, shows in certain instances a remarkable stability in the rates over the period. For example, poisonings by food during the first partial period were at the rate of 1.3 per 100,000, whereas, during the full period the rate was 1.2. The rate for burns (conflagrations excepted) was the same for the entire period as for the earlier period,

at the rate of 8.8 per 100,000. Accidental drownings varied but one-tenth of a point, the figures for the partial and complete periods being, respectively, 10.6 and 10.7. Traumation by fall during the earlier period was accountable for 13 deaths per 100,000 exposures and during the entire period for 12.9. And so for several other comparisons. It is encouraging to note that as against 3.3 deaths per 100,000 for the earlier period, due to electric railroad accidents and injuries, the figure for the entire period has been reduced to 3.0, indicating a considerable reduction in the added experience. The automobile accident fatalities, however, show a decidedly worse and discouraging condition. This is referred to specifically later on in Dr. Dublin's paper.

Dr. Dublin has indicated with regard to traumatism by fall that until after age 65 the mortality from this cause was not more than 25 per cent. of the total mortality from accidents and unspecified violence, but after that age the percentage suddenly jumps to over 50. The explanation probably lies in the greater susceptibility to fall on the part of older persons and in their weakened vitality for resisting the effect of fall.

Passing over several of the other studies, not for the lack of interest but in order not to take up too much time, we come to the important group of automobile accidents and injuries. Here we find an astounding increase in the death rate per 100,000 of exposures during the period under review, the rate having more than trebled during the period, namely, from 2.3 per 100,000 to 7.4, the increase being at about the same rate for both sexes and without regard to color, except that the increase is not so marked among colored females, as to whom it occurs to me the fluctuations may be due to relatively small numbers exposed.

It would be interesting in connection with the mortality rate from this cause to know the rate of increase in automobile registrations during the period. We know that the increase in the use of automobiles during this period has been very great, and, if the study be made in comparison with this, the results may not appear quite so bad, although even under the most favorable presentation of the facts there is still evidence here of the need of vigorous action to minimize this cause of accidental death. Were the figures for automobile registration available, it occurs to me these studies might be of considerable value for check purposes in connection with automobile liability insurance.

In the case of fatal accidents from street cars, we find that with both sexes and colors the accident death rate has decreased during the period. Public liability being a large element of cost in connection with street railway operations, the street railways have naturally rapidly fallen in with the safety first movement, and this, I believe, accounts for the reduction. It will be noted that the reduction really did not come in until 1914, the death rates per 100,000 for 1911, 1912 and 1913 being substantially the same, 3.6

per 100,000. I think we can accept as about 1914 the date when the safety movement really took hold with these public service institutions.

Passing over many other interesting studies, we come to the one which is perhaps most interesting to casualty actuaries, that of accident fatalities arising out of and in the course of employment. In view of the fact that the classification of risks in personal accident insurance is largely dependent upon occupation, it is rather surprising to find that out of deaths among white males from those external causes which seemed most closely associated with occupation, amounting to 14,151, only 3,963 were of such a nature that Dr. Dublin could definitely assign them as occupational deaths, that is, only about 28 per cent. Dr. Dublin warns us that these were only from selected causes, which were considered mainly associated with the occupation, and that probably there would be some increase in the total occupational mortality from other causes. There might also be some increase in the proportion if more complete and accurate data were available as to the circumstances in all cases. Nevertheless, the proportion attributable to occupation seems small, particularly when we remember that this is an experience developed from the industrial classes engaged in the more hazardous occupations. The paper does not give us the variation as between occupation and occupation, which undoubtedly would be large, but even under those circumstances, which undoubtedly would be large, but even under those circumstances, on the face of the figures, comparing Table 2 and Table 26, it would appear that age was a much more important factor as regards accident fatality.

Yet age is not taken into consideration at all, so far as I am aware, in connection with the fixing of rates for personal accident insurance. If age is a factor in the production of the accident fatality rate and we are correctly attributing its influence to the lack of resistance to the effect of accident, then it would seem that age would be an even more important factor in the rate of disability from accident. May we hope that in the not distant future some of our members will present us an analysis of personal accident experience which will throw some light on this question?

In connection with this exhibit, one or two points strike one as curious, which doubtless Dr. Dublin can easily explain. For example, one of the causes separately studied is "Traumatism in Mines and Quarries," from which cause there were 443 deaths. Yet only 405 of these, or 91.4 per cent., were considered to be due to occupational stress. It is difficult to see, without further illustration perhaps, how it is that a fatality might occur under such circumstances that it would properly fall in this classification, and yet not have occurred under such circumstances as would bring it within the scope of a compensation act. Perhaps, however, Dr. Dublin has taken a sligthly different point of view in dealing with occupational cause than the point of view of a compensation act.

I might point out, in connection with Table 27, that it would be interesting if Dr. Dublin had given the rate of occupational accident fatality for the several years per 100,000 exposures. This, I think, would give a little clearer measure of the effect of accident prevention.

As casualty statisticians and actuaries, we are perhaps not as much interested in the portion of the paper dealing with mortality from suicide and homicide as we would be were our approach to the subject from a somewhat different point of view. Yet it seems to me not unlikely that in our practical work from time to time we will find much interest and help in the data Dr. Dublin has given us.

As I stated at the outset, in these few brief notes I do not pretend to have presented an adequate discussion of this paper. I am sure that, as individuals and as a Society, we all feel deeply indebted to Dr. Dublin and the Metropolitan Life Insurance Company for laying before us so much valuable information.

MR. H. E. RYAN:

Dr. Dublin's paper not only is a valuable statistical contribution but it contains points of practical underwriting value. This is particularly true of those tables which show the incidence of fatal accidents according to age. Recent mortality investigations among insured lives have shown that in general the rate of accident fatality increases with age. As a rule, however, it is not customary in the practice of personal accident insurance to grade the premium rates accordingly. One reason for this is that by a continuous process of elimination the insurance company seeks to get rid of undesirable risks; thus the hazard assumed tends to remain constant at all ages.

One or two companies recently have taken up the insurance of accident and health policies at graduated rates. These policies do not contain the usual privilege of cancellation at the instance of the company, so that the steadily increasing risk has to be anticipated in fixing the premium rate. Such policies of course provide not only accidental death benefits, but include provision for weekly indemnity on account of disability from either accident or sickness. The increase, due to age, of the sickness hazard is much more important than is the increasing risk of accidental injury, but the upward trend of the accident rate is nevertheless decidedly appreciable.

The fatality rate experienced among lives accepted for *commercial* accident insurance (as distinguished from monthly premium or *industrial* accident insurance) is approximately 100 per 100,000 exposed. Such insurance is usually granted upon lives ranging from 18 to 55 and the proportion of female lives is practically negligible. Dr. Dublin has kindly furnished the relative weights

of the exposures in the Metropolitan's experience, between ages 20–55 (white males). From this information it appears that the fatality rate among industrial policyholders is 134 per 100,000 or nearly 35 per cent. in excess of the corresponding figure for commercial risks.

The marked disparity between the male and female death rates is explained chiefly by the difference in degree of the respective exposures to fatal injuries. With the single exception of deaths from "burns" the male rate, in varying degrees, is higher than the female. We are dealing here not only with industrial workers but also with housewives, so that those agencies which produce fatal accidents are, to a considerable extent, absent. On the other hand "burns" account for 9.3 deaths among white females and 14.3 among colored females, per 100,000 exposed, as against 7.2 for white males and 8.4 for colored males. The reversal of form shown by these figures is doubtless due to the exposure in domestic occupations.

That portion of the paper commencing at page 40 throws light on the relative frequency of occupational to total deaths for the years 1912–16. The total number of deaths embraced in this study is 14,151 and as these are from "specified accidental causes" it is obvious that the exposures from which precisely these (and no other) deaths arose cannot be traced. Hence, the data given do not yield an absolute occupational death rate. It is possible nevertheless to use in a comparative way the percentages shown by years in Table 27. By combining these with the death rates for the corresponding years, a factor of *relative* occupational mortality is developed. The figures of Table 27 deal with white males 15 years of age and over. The nearest corresponding values of Table 28 would be those shown in the column under "white males" but through the courtesy of Dr. Dublin I have been furnished with the death rates for white males, ages 15–65, years 1912–1916. These have been combined with the percentages of Table 27 in the following manner:

Year.	Death Rates per 100,000 White Males Ages 15–65.	Percentage of Occupational to Total Deaths (Table 27).	Relative Occupational Fatality Rate.
1916	136.2	25.2	34.3
1915	119.3	23.3	27.8
1914	124.9	29.0	36.2
1913	143.5	32.3	46.4
1912	144.3	30.6	44.2

Expressing these derived percentages and also those shown in Table 27 in terms of the corresponding figures for 1912 we obtain the following differential comparisons for the years specified:

Year.	Proportion of Occupational to Total Deaths (Table 27).	Relative Mortality from Occupational Accidents.
1916	.82	.78
1915	.76	.63
1914	.95	.82
1913	1.06	1.05
1912	1.00	1.00

These comparative ratios are interesting in connection with Dr. Dublin's conclusion that "the proportion of deaths resulting from occupational accidents was on the decline during the five years under observation." The years covered by these comparative ratios fall naturally into two groups, 1912 and 1913 being those before workmen's compensation became an important factor in our industrial and economic life, and the remaining years those which saw the general adoption of compensation measures. The comparative fatality rates and the proportion of occupational deaths to the total of accidental deaths both show a distinct downward tendency after 1913 which possibly may be indicative, at any rate it is suggestive. The upward turn shown for the year 1916 is not necessarily contradictory for it will be remembered that there was in that year an unprecedented increase of industrial activity accompanied by greatly increased accident frequency.

MR. ARNE FISHER:

It might perhaps be of interest to compare some of Dr. Dublin's tables with the results of an analysis I recently made of the mortuary experience of insured lives (industrial white males) of the Prudential Insurance Company of America for the three-year period 1915–1917.

By means of my proposed method of compound frequency curves I constructed a complete mortality table for insured industrial white males for all integral ages from 10 and upwards to the limiting age of the table. The compound frequency curve eliminates the requirements of having detailed information about the exposed to risk at various ages and makes it moreover possible to compute not alone the general death rate, q_x, from all causes of death, but specific death rates from any particular cause or group of causes as well. Moreover, the rates thus produced are automatically graduated, and the work of graduating the crude "central death" rates, such as presented by Dr. Dublin in 10-year age intervals, is not added to the final computation of the specific death rates.

The compound frequency curve method enables us thus to construct a table of graduated rates of death from accidental and unspecified violence, exclusive of suicide and homicide. This table for white males may be compared with Dr. Dublin's crude rates for white males in his Table No. 2 except for the fact that war deaths

were included in the Prudential experience. This would tend to increase the rates for younger ages from 17 to 30. The rates, of course, are not influenced by the heavy war casualties of 1918 when America threw her full strength into the conflict, and which of course falls outside the range of the period under investigation. Most of the war claims are from Canadian policyholders and American volunteers in the Allied armies.

We give below the automatically graduated rates of the Prudential experience. These rates which in the table are given for quinquennial ages only are also shown in graphical form for all ages in Fig. 1.

GRADUATED DEATH RATES, q'_x, FROM ACCIDENTAL AND UNSPECIFIED VIOLENCE. Prudential Industrial White Males, 1915–1917.*

Age.	q'_x.	Age.	q'_x.	Age.	q'_x.
17	.00128	42	.00137	67	.00284
22	.00130	47	.00142	72	.00334
27	.00131	52	.00160	77	.00390
32	.00132	57	.00194		
37	.00135	62	.00243		

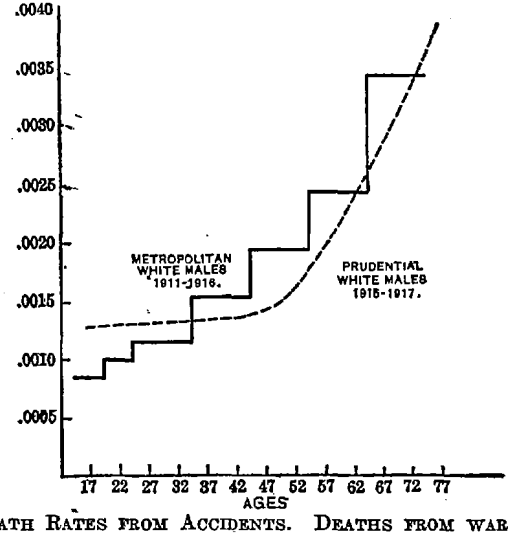

FIG. 1. DEATH RATES FROM ACCIDENTS. DEATHS FROM WAR INCLUDED IN PRUDENTIAL EXPERIENCE, BUT EXCLUDED IN THE EXPERIENCE OF THE METROPOLITAN LIFE INS. CO.

A direct comparison of these rates with Dr. Dublin's "central death" rates for 10-year intervals is impossible without further adjustments, because:

* War Deaths included.

1. Death from war are included in the Prudential experience, which as already stated would tend to increase the rate for younger ages.

2. Dr. Dublin's figures are in all probability based upon amount exposed to risk rather than the true number of lives exposed to risk. This would, except for assurance of the lives of children, tend to increase the rates for adult ages from say 20 and upwards. This well known fact has been borne out by several investigations among industrial insurance companies in England and on the continent. The industrial mortality experience of the large company "Victoria" of Berlin shows that mortality rates based upon amount insured are from 2 to 10 per cent. higher than the true rates based upon life exposures. The increase is especially marked in the life period from 35–55. Is it not possible that policyholders belonging to certain dangerous occupations and who can not obtain ordinary insurance at normal rates are apt to take comparatively large sums of industrial insurance in comparison with the great bulk of industrial policyholders? If this should be the case, it is readily seen that the accident death rate when based upon amount assured would be higher than the true death rate based upon lives exposed to risk.*

3. Dr. Dublin's figures are crude "central death rates" which have not been subjected to a process of graduation. This important distinction is seen from a mere glance at Fig. 1 where the Prudential rate is given as a continuous curve, while the Metropolitan figures are shown as a broken diagram.†

In the construction of mortality tables by means of compound frequency curves from the number of deaths by age and cause and independent of exposures we do not meet the difficulty of basing the rates upon amount insured. The ultimate rates are true death rates.

As an additional matter for comparison we give below the graduated suicide rates for white males.

* I may in this connection also mention that attempts of taking samples among both death claims and policies in force in order to determine the exact correlation factors between amount exposed and lives exposed to risk have proven failures among European companies. The exact determination of such a correlation either by regression equations or other methods is indeed a very difficult problem. If Dr. Dublin has succeeded in solving it to complete satisfaction he is indeed to be congratulated, and his formulas—if such have been developed in this connection—would be extremely valuable, not alone in this particular investigation but in general mathematical statistics as well.

† The very common method used by Dr. Dublin to draw "central death rates" in the form of a frequency polygon or broken curve is not one to be recommended. (See T. N. Thiele, "Theory of Observations," page 11.)

GRADUATED DEATH RATES, q''_x, FROM SUICIDE.
Prudential Industrial White Males, 1915–1917.

Age.	q''_x.	Age.	q''_x.	Age.	q''_x.
17	.0000501	37	.0002920	57	.0006067
22	.0001231	42	.0003263	62	.0006613
27	.0001852	47	.0003781	67	.0006592
32	.0002645	52	.0004800	72	.0005895

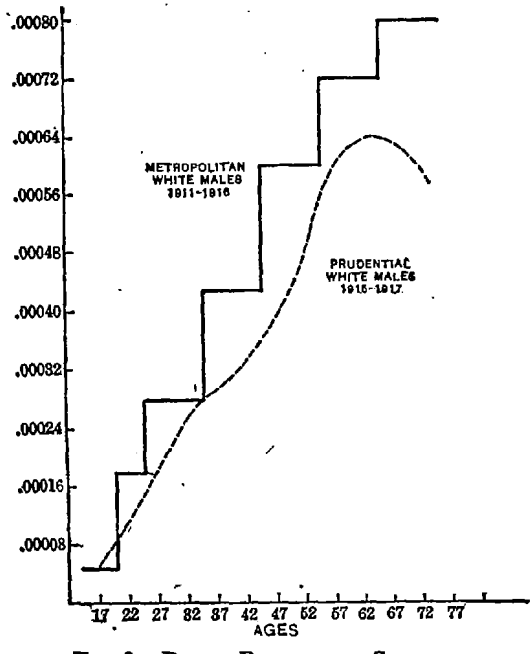

FIG. 2. DEATH RATES FROM SUICIDES.

From the graph in Fig. 2 it appears that the Prudential graduated rate is lower than the corresponding Metropolitan rate. It is quite possible that a careful editing of the number of deaths classified under "poisonings," "inhalation of gas," "drowning," *etc.*, similar to that mentioned by Dr. Dublin in his footnote on page 43 would tend to increase the rate for the Prudential experience. The graduated curve exhibits the same form of a pronounced maximum crest in the age intervals 60–64 as pointed out in previous investigations on the suicide rate by Knibbs of Australia and several Scandinavian investigators.

For homicides the trend of the Prudential graduated curve seems to follow that of the Metropolitan quite closely.

The general increase with age in the death rate from accidents as shown both in the Metropolitan and Prudential experience does by no means come as a surprise. This well known and long established fact has repeatedly been brought to light by investigators, such as Westergaard and Knibbs.

The remarks on death from purely occupational accidents in Dr. Dublin's paper do not pay any attention to the age factor. It is of course by no means an easy matter to classify an accident as purely occupational in nature. While undoubtedly most of the deaths in mines and quarries arise from occupational hazards, it is on the other hand difficult to classify burns, falls, etc., as due solely to occupation. English statistics are somewhat superior in this respect as compared with America data. From an analysis by frequency curve methods I find that the age factor in purely occupational accidents does not play so great a rôle as in ordinary accidents, *i. e.*, non-occupational accidents.

In an analysis of the experience of deaths from accidents in the case of American Locomotive Engineers by means of compound frequency curve I found the death rate of death from accidents, typhoid fever and a few minor causes of death combined into one single group. (Suicides were excluded.)

The vast majority of deaths in this grouping (probably more than 90 per cent.) are due to railroad accidents, and the rate in this group may therefore properly be looked upon as essentially occupational in nature. I give below a comparison of the death rates for the two periods 1893–1906 and 1913–1917 in the above mentioned grouping:

Age.	1893–1906.	1913–1917.	Age.	1893–1906.	1913–1917.
25	.00651	.00428	50	.00625	.00402
30	.00710	.00380	55	.00640	.00457
35	.00706	.00347	60	.00641	.00486
40	.00640	.00343	65	.00613	.00472
45	.00614	.00367	70	.00567	.00460

This table needs no further comment.

COMPARISON OF ACTUAL AND EXPECTED LOSSES AS A MEANS OF LOSS ANALYSIS—A. H. MOWBRAY.

VOL. V, PAGE 80.

WRITTEN DISCUSSION.

MR. WILLIAM LESLIE:

The results of Mr. Mowbray's investigation into the increased disability due to infection of injuries caused by industrial accidents are, in my judgment, of much less importance than the emphasis he places upon the value in casualty insurance of comparisons between actual and expected events.

The final figure of two and one-half times the average disability in uninfected cases is not a general measure of the effect of infection because the method of weighting deaths and permanent partial disabilities makes the result a function of the scale of compensation for these two types of cases. An error may also exist in this figure because of the two following conditions for which proper allowance has not been made.

First, in comparing the actual with expected for the temporary cases, no consideration seems to have been given to the fact that a very considerable number of cases would have caused no disability and hence not have counted as tabular accidents had it not been for infection. In other words, infection not only increases the average duration of disability in temporary cases but it also increases the number of such cases. Therefore, the result is too low by an amount, the measure of which cannot be obtained from the data in hand but which probably would be quite appreciable.

The other condition is the effect of infections in permanent partial disability cases. A case which is already a permanent partial disability, such as a dismemberment, where the infection may increase the period of temporary disability but not the extent of permanent injury, would be improperly treated by the method used. A case which is temporary but rendered permanent because of infection is compared with the average cost of uninfected permanent disabilities whereas the comparison should be made with the average cost of uninfected temporary disabilities. These two types of infected permanent disability cases tend to offset one another but how effectively, it is difficult to say.

Any question however as to the value of the result secured in this instance does not run to the principle employed but only to some of the details connected with the preliminary preparation of the data. As pointed out in the paper, precautions must always

be taken to prevent wrong deductions but with such precautions the method provides one of the most valuable means of solving many problems in casualty insurance.

Several of these problems have been mentioned by the author but his reference to life insurance as the source of the practice of comparing actual with expected events brings to mind one, the solution of which should be undertaken at an early date and which can be handled very nicely on this basis. I refer to the necessity of checking up on the mortality and remarriage tables which were introduced in the State of New York for the valuation of certain benefits and which have come to be rather universally considered standard tables. Following the example of life insurance companies which in their gain and loss exhibit calculate their profit or loss from annuities, a very valuable comparison could be made between the actual experience under annuities payable to beneficiaries under compensation and the expected experience indicated by the present table.

MR. A. H. MOWBRAY:

(AUTHOR'S REVIEW OF DISCUSSION.)

I am greatly pleased to find that Mr. Leslie so heartily approves the method suggested in this paper, as I have, since writing the paper, seen other instances where the method has proved exceedingly useful. For example, a friend of mine was investigating the sickness experience, by occupations, of a benefit association and found apparently a marked difference in the crude sickness disability rate between two occupations, *e.g.*, butchers and bakers, for which the apparent explanation was a difference in the age distribution in the particular experience. Obviously, however, this explanation could not be accepted without check. He discussed it with me and I suggested that he take a standard disability table showing the rates of sickness disability by age, such, for example, as the general table developed from the Leipzig Communal Sick Fund experience, and apply the rates from such table to the exposures in the several age groups in each occupation. This would give the expected disability, which was then to be compared with the actual disability recorded. The comparative ratios of actual expected would then indicate whether or not the difference in the crude disability rates really represented difference in disability according to occupation or difference in age distribution of the risks under observation. The work is not yet completed, but it is my understanding that the method is satisfactorily checking out this difference.

Mr. Leslie raises some questions as to the details of working out the particular problem which suggested this paper. He first points out that the figure of two and one-half times the average disability in uninfected cases as the average disability in infected cases is in-

fluenced by the relative weight given deaths and permanent disabilities. I recognized that this is so and endeavored to point this out in the second paragraph on page 83, suggesting that, if need be, a corrected scale might be used, but observed: "For the purposes in hand this does not seem necessary." I am glad Mr. Leslie has further emphasized this important point.

Mr. Leslie also points out that there may be cases of non-compensatable temporary disability which become compensatable after infection takes place, thus being for the first time brought within the line of vision, and that the relative cost of infection cases is not estimated when this is not brought into account. In principle he is right in his criticism, but, as I pointed out on page 82, the Workmen's Compensation Act of the State of Washington contains no waiting period, and therefore, theoretically at least, we get all cases reported. I am inclined to believe, however, that certain minor injuries are passed over and unreported, even under this Act, until after infection sets in; so that, were it desirable to get such a precise measure of the relation in cost between infected and uninfected cases as would be necessary for monetary calculations, some further allowance should be made for this.

Mr. Leslie also points out that in cases of permanent partial disability, infection may extend the time of temporary total disability without increasing the severity of the permanent impairment, and that this would not be taken account of in a comparison along these lines, using the particular statistics available. This, again, is true; but whether or not this factor should be taken into consideration depends somewhat upon the purpose of the comparison. If the compensation act provides, as does New York, for example, a fixed compensation for certain types of permanent disability without regard to the associated temporary disability, then, clearly, no additional cost, except medical cost, is created by this more extended temporary disability. On the other hand, if the compensation act is like that of Massachusetts, where the total disability benefit is payable as long as total disability exists and an additional compensation benefit is payable for permanent partial disability, then the statistics compiled along the lines of the Washington data would bring this into account.

The precise figure of comparative cost is perhaps even more open to criticism from a different point of view, namely, even though the Washington Act has provided no medical benefit, and, therefore, the medical service rendered is probably less than is generally furnished in a compensation state, yet some medical services were furnished in all of these cases and to a certain extent the infection was checked and controlled. Had it not been for this, undoubtedly, the relative cost would have been even higher, and, therefore, the figures as to relative cost of infected and uninfected injury must be used very guardedly, if used at all, for the basis of medical allowance or other provision in connection with injuries.

The comparison which led to the presentation of this paper was for use at a Safety Congress for the purpose of stressing the importance of preventing infection, and, therefore, only rough approximate figures were necessary.

As Mr. Leslie says, however, these details do not involve the principle of the method suggested.

I am very glad to find that Mr. Leslie suggests that we use this method to check up temporarily the appropriateness of our mortality and remarriage tables used in valuations under the New York and other compensation laws. There is probably not yet a sufficiently matured experience upon which to establish a truly American remarriage table, but in the meantime tests along these lines may go far to satisfy us of the suitability of the tables we are using.