HAS THE INDUSTRIAL ACCIDENT RATE DECLINED SINCE 1913?

BY

LEWIS A. DEBLOIS*

DIRECTOR, SAFETY ENGINEERING DIVISION, NATIONAL BUREAU OF CASUALTY & SURETY UNDERWRITERS

The condition and form of our federal and state accident statistics do not permit the formulation of a satisfactory answer to this question. As United States Commissioner Ethelbert Stewart has continually pointed out, adequate machinery for the collection of industrial accident statistics simply does not exist—it is as though we were so little interested in these deaths and injuries that we did not care even to count them!

In the absence of dependable statistical information, we are compelled to fall back upon generalization, deduction and surmise—methods too loose to satisfy the actuarial mind. What follows, therefore, is submitted to you with considerable mental reservation. It constitutes, however, the best answer I can make to the difficult question that has been propounded.

Let us clear the way by disposing of an impression which seems to be rather prevalent in extra-insurance circles: that, by virtue of the compensation laws, either those who enforce them or those who make the compensation insurance rates must have accumulated statistical information which could be made to show the trend of industrial accidents. The negation of this is a simple matter. There are supposed to be annually from 18,000 to 25,000 fatal industrial accidents in the United States, and about 130 times as many non-fatal "lost-time injuries."† Under the compensation laws there were reported in 1925 to 43 state authorities and one federal authority‡ only about 11,000 accidental deaths and 1,700,000 non-fatal injuries. The remaining deaths and injuries, presumably 40-60% of the total, were not reported because they did not fall within the scope of any compensation law. As this latter group is heavily weighted with accidents incurred in special employments and in extremely small establishments, the reported cases are probably not a representative

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†Injuries entailing loss of working time other than the balance of day or shift on which injury was incurred.
‡U. S. Compensation Commission.

cross-section but a selection. Because the application of com-
pensation enactment operates to lessen accident occurrence, the
selection is favorable; that is, probably better than average.

So much for state statistics; in the insurance field we have a
further selection of the compensable group in which cases coming
under self-insurance are excluded. This is a selection of a
selection, and we cannot assume that it is representative of the
entire industrial situation; probably it is not. As there were
reported for all states in policy-year 1925 only 4027 fatal cases
and 367,998 non-fatal cases (Schedule Z), we have here only
16-22% of the whole story, and we cannot tell which part of it
it is. It may be either a favorable or an adverse selection.

In this paper I propose to attack the problem from the opposite
side. Let us consider first those parts of the Mortality Statistics
of the Bureau of the Census which deal with accidental deaths;
that is, deaths from external causes excluding homicides and
suicides. You are aware that the health departments, medical
examiners, etc., of the states report to the Bureau of the Census on
blanks which permit classification of causes of death in accordance
with an internationally accepted list. This list appears to have
been compiled originally with the medical viewpoint predominat-
ing, and, although slight improvements have been made from
time to time in the matter of accidental death causes, it is still
very inadequate and confused. It is a mixture of general ac-
cident causes (e. g., "traumatism by fall"), accident causes special
to industrial exposures (e. g., "traumatism in mines"), and broad
physiological terms which may be neither accident causes nor
even the proximate causes of death (e. g., "fractures"). Another
inconsistency is introduced by the method of classifying deaths
from accidents involving two classes of vehicles under the caption
relating to the heavier vehicle. Thus, deaths from automobile
and railroad train collision are classified as railroad accidents
rather than automobile accidents.

The above relates to the sub-classifications. So far as the total
of reported accidental deaths is concerned, admitting that it
includes some homicide cases, probably lacks a considerable
number of cases where accidental injury predisposed the victim
to a disease of which he later died, and includes a considerable
number of suicides which kindly disposed medical examiners and
coroners have permitted to pass as accidents, I believe that it

still gives a fair picture of what is taking place in the registration area, and that its accuracy changes little from year to year.

The mortality rate derived from these reported deaths must be taken with more reservation. It is based upon the population by census or as estimated for non-census years. This is a satisfactory basis for mortality rates on causes of accidental death which are general and conceivably affect all classes, sexes and ages alike, but it is less satisfactory where the exposure to accident is special and limited. For example, few persons other than miners are likely to suffer traumatism in mines. We can go further and say that the very large, important and impressive sub-classification of automobile accidents can be conceived really to consist of three parts—accidents to the public, to passengers and to drivers. In the first two, we can conceive that all classes and ages of citizens are exposed to the hazard, and indeed one-third of the victims are children. In the case of drivers, however, the exposure is almost exclusively to adults, and a rate based upon the total population is therefore misleading and not comparable with the balance of the automobile accident mortality rate. As the number of deaths from automobiles is rapidly increasing and already represents almost one-quarter of the total accidental deaths, this matter is of some importance.

Bearing in mind these natural inaccuracies in the total rate as computed, let us examine its course rather than its value. It is shown in Fig. I together with three straight-line trends by the method of least squares. The trend which is marked A is for the entire 25-year period. Its equation is:

$$y = 86.324 - .522\,x$$

Its standard deviation is ± 5.16, the standard error of estimate is ± 3.53, and correlation between x and y is $- .730$. This seems to establish the existence of definite downward trend in the rate during the past quarter-century. The decrement has a present value of about 500 fewer deaths a year. If continued, the millenium of no accidental deaths would take place in A. D. 2065—but this is absurd since the rate does not and never will follow a straight line!

Line B has been computed for the period 1900 to 1912, and Line C for the period 1912 to 1924. Their respective equations are:

$$\text{(B)} \quad y = 84.501 - .236\,x$$
$$\text{(C)} \quad y = 94.748 - .974\,x$$

This suggests that, notwithstanding the advent of the war, the decline has been more rapid during the later period and has a present average value above 1,000 lives a year. This, you will admit, is encouraging.

I desire to call particular attention to the behavior of the rate itself from 1913 on. Here commenced a rapid decline which was sharply reversed in 1915 on our participation in the war, but this decline was resumed in 1919 and continued through 1921. This is indicated in the diagram by the dotted line paralleling the trend C. In 1921-22 there was a violent reversal. In the whole 25-year period we have six sharp reversals of the curve, the three most significant being reversals from downward to upward trend in 1908-09, 1915-16 and 1921-22, the indication of reversal in each case being sustained by at least four years' experience.

Here seems to be something quite remarkable—the ability of the accident rate of one hundred million people suddenly to reverse itself. For such a large group, one would expect a fairly smooth curve in view of the wide variety in the nature and causes of accidents—such a curve, for example, as presented by some of the disease death-rates. Since changes in population occur too gradually to account for it, it must be due to abrupt change in the number of accidental deaths.

With this thought in mind, let us examine some of the principal components of the total number of deaths. To simplify the process, certain of the so-called causes have been grouped: "burns" includes "conflagrations"; all forms of poisoning are grouped with suffocation and gassing; traumatisms in mines and quarries are combined; "other transportation" includes street-cars, airplanes, balloons and "other vehicles"; "fractures" is combined with "traumatism by cutting and piercing instruments" and with "landslide, other crushing." In "electricity", however, lightning is excluded. Under this grouping the number of deaths for age groups 20-64 appears in Fig. II as index numbers commencing at the year 1918. This selection of age groups was made to dispose of distortions due to the inclusion of the young and those of advanced age. The relative importance of each component for the year 1924 is indicated by percentage figures at the right. Furthermore, all curves have been grouped in the diagram according to their general form and behavior. These groups are lettered. A, B and C.

In the five curves of Group A we note marked and evidently associated reversals in 1921-22. In the three curves of Group B, there are less marked indications of this. In Group C the reversal is apparently absent. Groups A and B with an aggregate importance of 44.9% (in 1924) include practically all major causes having strong industrial significance. The behavior of these eight curves is strikingly similar and leads at once to the deduction that in 1921-22 there was at work some dominant factor affecting the accident possibilities of the entire adult population and itself capable of sudden reversal.

What factors or influences of this sort exist in life and sway the destinies of thousands of people? We may at once eliminate from consideration those incapable of sudden change. These include the influence of education, of which the safety movement is a part, and of scientific development, of which the safety movement is again a part, and the mechanization of industry and of life in general is also a part. These are dominant forces and doubtless have much to do with the gradual downward trend of the accident rate shown in Fig. I, but they are incapable of creating abrupt major changes.

Climatic changes are abrupt and do exert an effect on certain classes of accidents—notably drownings. War has a major and sudden effect on life and is capable of doing exactly what is shown in Fig. I; in fact, the earlier parts of the curves in Fig. II represent the post-war return to normal conditions. Fashions are capable of sudden change and have a surprisingly far-reaching effect on many of our undertakings, though hardly upon industry or life as a whole, even though we are rapidly becoming a standardized nation. To none of these influences, however, can we attribute the sudden change in the mortality rate in 1921-22 and, previously, in 1908-10, even though we may cite war as the cause of the reversal in 1915-16. Some of them may have been contributory, but certainly none was dominant.

We discover the dominant factor which is capable of causing abrupt change when we study the statistics of business and employment. If you will refer to the charts of indexes of employment on pages 50 and 55 of "Business Cycles and Employment"*

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*Report and Recommendations of a Committee of the President's Conference on Unemployment, McGraw-Hill Book Company, Inc., New York, 1923.

and compare them with Fig. I, you will find that the cycles of the mortality rate correspond closely with the cycles of the adjusted employment index. There has been no opportunity to work out the correlation, in fact, the basic figures used for the employment charts are not included in the text, but I believe a high degree of correlation could be shown.

It is not my intention to assert, however, that employment is the dominant factor which controls the behavior of the accident mortality rate, but the employment cycle follows closely the business cycle and the condition of economic prosperity is, in my opinion, the factor dominating our total accident mortality rate. The low points in the latter do coincide with the low points of industrial employment, but each in turn follows closely a so-called business "panic," "crisis" or "depression" and is but a symptom of a common disorder. We know that the economic prosperity of the country is subject to rapid change, and may be upset in less than a year and the whole nation profoundly affected thereby. William Berridge has said that employment conditions are a connecting link between business and social conditions, and that cycles of suicide, crime, pauperism, marriage and migration follow the fluctuations in the economic prosperity of wage-earners; it would not be strange to find accidental deaths and injuries in the same company†.

It is not difficult to rationalize this thesis which, by the way, is by no means a new thought and has previously been stated before this society. Economic prosperity dominates employment and employment dominates exposure to industrial accidents. There are also indirect effects: when men are laid off, "selective discharge" takes place and accidents decrease; when men are taken on, the hiring is less selective and the new employee is more prone to injury than his fellows—furthermore, under pressure for accelerated production, we are apt to have men and machines taxed to the utmost, much old equipment pressed into service, minimum attention to repairs, and new production methods hastily adopted and put into use without adequate trial. Such conditions inevitably produce more accidents.

Outside the industrial field, I think it can be said with truth that better economic conditions give us more opportunity and

†Since the preparation of this paper it has been possible to compare current income per capita, as reported by the National Bureau of Economic Research, with the accident mortality rate. Fig. VI reveals the presence of a considerable degree of cyclic coincidence.

more incentive to expand our lives, to do more recreation, to travel, to acquire new possessions, to follow new hobbies. The result must be increased exposure outside the confines of the home and exposure to hazards with which we have less contact when life is more a matter of routine. Greater activity and wider activity inevitably bring increased accident exposure.

We may go further and look for evidence of the domination of economic prosperity in the compensation statistics of states and of the insurance carriers. We may trace its effect in the form of the curves in Figs. III‡, IV, and V—all of which show evident similarity in form to those of Group A in Fig. II. I think similar effects can be found in the accident experience of practically all large groups.

This completes the generalization. I deduce the theory that the fluctuations or cycles of the general accident mortality rate are the reflection of the cycles of economic prosperity, and I surmise that they will be with us for many years to come—and always to the discomfiture of the makers of casualty insurance rates. I am infinitely more interested in the mortality rate trend. It signifies that in some fields of hazard there has been a change for the better. That change is certainly not taking place on our streets and highways, and I see no reason for believing that the safety movement has penetrated and implanted itself in the home. There is no other place for it but within industry itself and that is where we should expect to find it. The one greatest drag on safety progress is the human obsession to argue about the relative responsibility for an accidental occurrence. If you do not believe me, listen to an argument between two automobile drivers involved jointly in a collision! Out of such argument usually comes nothing of constructive value. In the industrial field this obstruction to progress was effectively removed by the enactment of compensation laws, and forthwith the industrial safety movement gathered headway.

It must be remembered that there is unmistakable proof of very real accident reductions within industry. The entire iron and steel group has reduced accident frequency progressively from 59.2 in 1910-14 to 29.9 in 1922-26 (five-year moving averages) and severity from 4.1 to 2.8. Ninety per cent of the

‡Compensable deaths reported by 21 states, all being states which have reported with reasonable regularity in the period 1918-24.

cement industry (Portland Cement Association) from 1920 to 1925 reduced frequency 29% and severity 30%. The American Railway Association reports 22.1% decrease in casualties to employes per million man-hours in 1926 as against 1923. This followed a five-year period in which the fatality rate was the lowest since 1898.

These groups are uniform in their consistency, but we also have two large non-uniform groups. The first comprises member companies of the National Safety Council who have reported consistently for two or more years. The records by trade "sections" show a number of consistent reductions in frequency and severity. For 1925-26, 687 plants of various sorts employing nearly a half-million persons reduced accident frequency 13% and severity 11%.

The second group consists of 13,898 companies engaged in twenty major industries and employing 2,454,413 persons. This group supplied information to the Safety and Production Committee of American Engineering Council for the research promoted by the National Bureau of Casualty and Surety Underwriters, the report of which will soon be published. This is a large and heterogeneous group, but in the aggregate it has reduced the frequency of accidents 18.5% between 1922 and 1925. We learn much more, including the facts that a group of 25 chemical plants have made considerable reduction in frequency (and some of them have reduced severity), and that 131 metal working plants, employing 107,588 persons, reduced frequency 11.5% and severity 3.9%.

To the above might be added almost endless instances of marked and sometimes remarkable reductions by individual companies or plants, many of which are operated by large corporations. It is here that one finds the brightest side of the industrial picture and comes inevitably to the conclusion that much real progress has been made. But there is also a dark side. The coal mining industry has not had a creditable record, and in the bituminous field the rates are not only high, but are increasing. The records of the woodworking industry, such as they are, offer little encouragement. Some of those of the textile industry are still worse and in single groups increases as great as 300% in four years have been recorded. Aside from this, we know very little of what is going on in very small
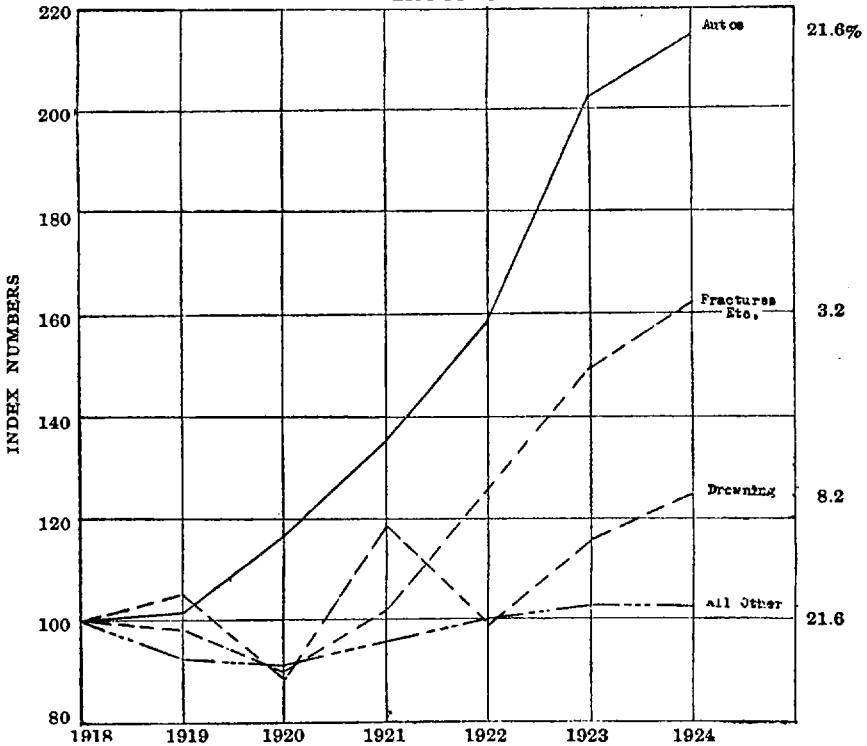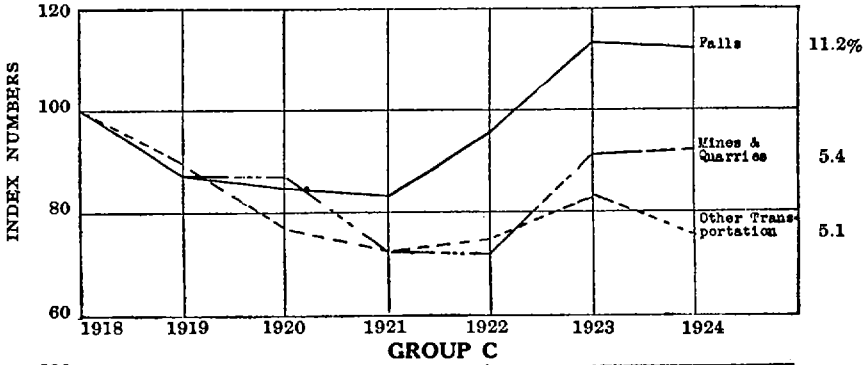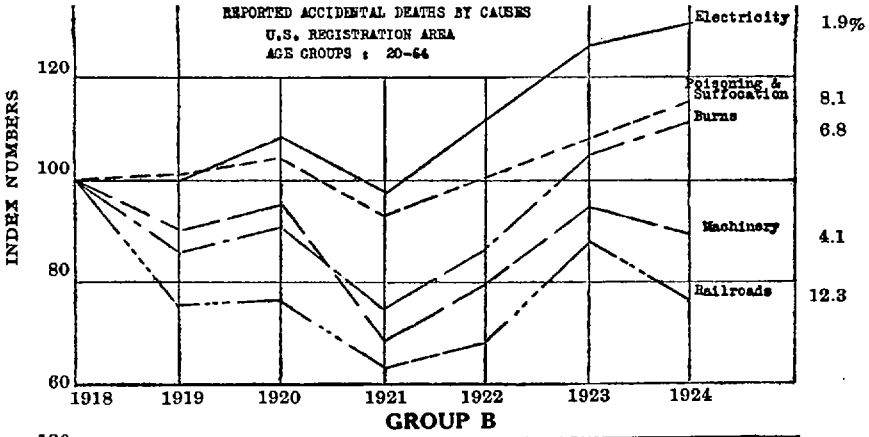
industrial establishments of all sorts. The rates may be stationary or they may be increasing. We do know that in 1924-25 in New York State the stock, mutual and state fund experience showed for such risks a loss ratio almost double that of the large risks.

Notwithstanding much bad experience, known or conjectured, I am optimistic enough to believe that the tide has turned and the industrial accident rate has actually declined since 1913. In the case of state statistics, I think the downward trend has been masked by more complete reporting of cases superinduced by progressive liberality in interpretation and application of the acts, and possibly by increased actual, but not necessarily calculated man-hour exposure. As for insurance experience, I feel that as yet it contains nothing sufficiently basic to give us any idea of the general industrial accident rate trend.

These are personal beliefs which I cannot support with evidence. Perhaps such evidence does not exist, but that, at least, should not deter us from doing our utmost to strengthen the general conviction that accidents can and should be prevented.

FIG. I
ACCIDENT MORTALITY RATE
ALL CAUSES
U. S. REGISTRATION AREA
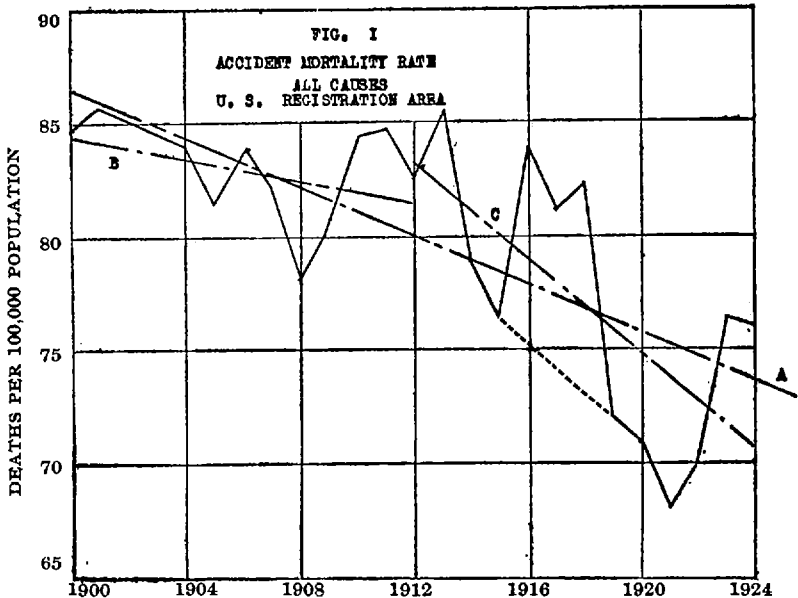
REPORTED ACCIDENTAL DEATHS BY CAUSES
U.S. REGISTRATION AREA
AGE GROUPS : 20-64

GROUP B

GROUP C

FIG. III
NUMBER OF
ACCIDENTAL DEATHS PER YEAR

Registration Area
All Causes
Ages: 20-64

Compensable
Cases

Reported by 21 States

FIG. IV
NUMBER OF COMPENSATION DEATHS
SCHEDULE Z

By Policy
Year.

Adjusted
to Calendar
Year,
on 50/50 basis

FIG. V
COMPENSATION CLAIM FREQUENCY
MANUFACTURING INDUSTRIES

Fig. VI

CURRENT INCOME PER CAPITA AND ACCIDENT MORTALITY

Accident Mortality Rate,
Registration Area,
All Causes

Estimated Current Income
Per Capita, 1913 Dollars

UNIT=ONE STANDARD DEVIATION OF PERCENTAGE DEVIATIONS FROM THE NORMAL