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-

* Manager, Accident Prevention Dept., Massachusetts Employees Ins. Assn., Boston, Mass.

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 Reported.	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 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.....	14.0	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-

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."

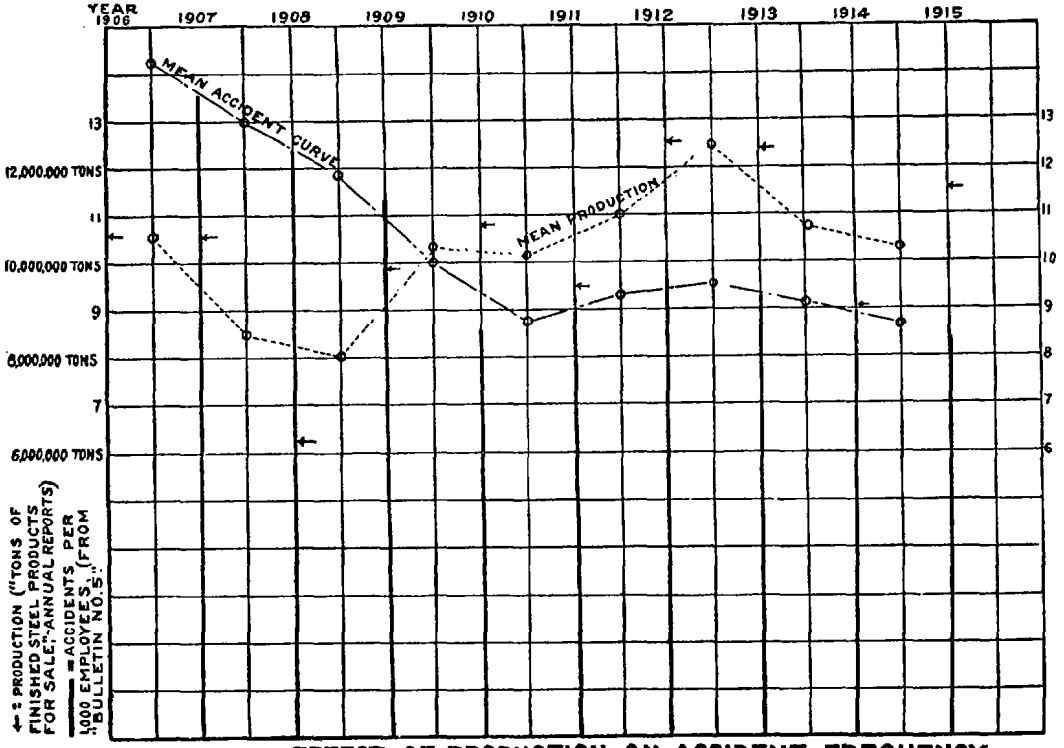

CHART SHOWING EFFECT OF PRODUCTION ON ACCIDENT FREQUENCY.
(FROM U.S STEEL CORPORATION DATA.)

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.