

U. S. DEPARTMENT OF LABOR
JAMES J. DAVIS, Secretary
BUREAU OF LABOR STATISTICS
ETHELBERT STEWART, Commissioner

BULLETIN OF THE UNITED STATES }
BUREAU OF LABOR STATISTICS } **No. 339**

INDUSTRIAL ACCIDENTS AND HYGIENE SERIES

**STATISTICS OF INDUSTRIAL ACCIDENTS
IN THE UNITED STATES**

By **LUCIAN W. CHANEY**



JUNE, 1923

WASHINGTON
GOVERNMENT PRINTING OFFICE
1923

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
10 CENTS PER COPY
PURCHASER AGREES NOT TO RESELL OR DISTRIBUTE THIS
COPY FOR PROFIT.—PUB. RES. 57, APPROVED MAY 11, 1923



II

CONTENTS.

	Page.
Introduction.....	1-4
State accident records for 1917 to 1921.....	4-8
State accident records for 1920.....	8-23
Arkansas.....	9
California.....	9
Idaho.....	10
Illinois.....	10
Indiana.....	11
Kansas.....	11
Maryland.....	11, 12
Massachusetts.....	12, 13
Minnesota.....	13, 14
Montana.....	14
Nevada.....	15
New Jersey.....	15, 16
Oklahoma.....	16
Oregon.....	16, 17
Pennsylvania.....	17-21
Washington.....	21
Wisconsin.....	22, 23
Wyoming.....	23
Summary:	
Industries.....	24, 25
Cause of injury.....	26
Nature of injury.....	26, 27
Location of injury.....	27
Steam railways.....	28, 36
Trainmen.....	29-31
Nontrain employees.....	31-35
Grade-crossing accidents.....	35, 36
Iron and steel industry.....	36-45
Mines, quarries, and metallurgical works.....	45-51
Coal mines.....	45-47
Metal mines.....	48, 49
Quarries.....	49
Metallurgical plants.....	50
Coke ovens.....	50, 51
Miscellaneous industries.....	51-60
Agricultural machinery and supplies.....	51, 52
Automobile industry.....	52, 53
Building construction.....	53, 54
Copper works.....	54
Electrical apparatus.....	54
Explosives, dyes, and chemicals.....	55
Light and power.....	55, 56
Machine building.....	56
Manufacture of cameras.....	56, 57
Manufacture of Portland cement.....	57
Paper mills.....	57, 58
Petroleum refining.....	58
Rubber industry.....	58, 59
Rubber tires.....	59
Tool manufacture.....	59
Woodworking and logging.....	59, 60
Conclusion.....	60

BULLETIN OF THE U. S. BUREAU OF LABOR STATISTICS

NO. 339

WASHINGTON

JUNE, 1923

STATISTICS OF INDUSTRIAL ACCIDENTS IN THE UNITED STATES.

INTRODUCTION.

The United States Bureau of Labor Statistics has issued two bulletins attempting to bring together accident statistics on a national scale. These bulletins, prepared by Dr. Frederick L. Hoffman, were issued in 1908 and 1914.¹

In the introduction to the later bulletin (Bulletin No. 157) Doctor Hoffman says: "At the present time there are no entirely complete and trustworthy industrial accident statistics for even a single important industry in the United States. The most reliable data are for the iron and steel industry, mining, and the railways." As will appear further on, it is still the case that the three industrial groups mentioned are the only ones whose statistics are being assembled with reasonable accuracy and completeness on a national scale. This is due to the fact that three Federal agencies, namely, the Interstate Commerce Commission, the Bureau of Mines, and the Bureau of Labor Statistics, have undertaken the task of collecting the facts and putting them in form for use.

During the period for which these agencies have assembled these data the whole vast system of workmen's compensation laws has grown up, with the result that a large majority of the States have come to have a new interest in the preparation and use of accident statistics.

It would seem to be reasonable to expect that the published results of this statistical activity on the part of the States could be brought together in such a fashion as to give a national view of the whole industrial field. The present bulletin attempts, among other things, to do this. It will, however, be necessary, unfortunately, to point out the serious shortcomings which render this huge mass of data less useful than it should be.

Two things ought to be done regarding industrial accidents: (1) They should be prevented; (2) such as can not be prevented should be adequately compensated. When the idea of compensation for industrial accidents entered the field of legislation less than 15 years ago there was already in existence machinery intended to take care of the matter of accident prevention. The factory inspection organizations in the various States had, during their period of existence, relied for

¹ U. S. Bureau of Labor Statistics Bul. No. 78: Industrial accidents; Bul. No. 157: Industrial accident statistics.

results upon the orders which they issued and the prosecutions which they instituted. Few statistics were gathered, and such as were compiled were of doubtful utility from the accident prevention standpoint.

In some States the compensation law consolidated the factory inspection with the administration of compensation in an industrial commission. In others the two functions were kept independent. It is impossible to administer a compensation law without securing large amounts of statistical information. Consequently the reports required from industrialists were expanded to include the items needed for compensation purposes, but as the commissioners in practically every State were soon engulfed in the multiplied details of compensation administration, and the problems of accident prevention were considered as belonging to factory inspection, not much has been done in the statistical study of accident prevention.

There are five things which must be known regarding groups of accidents if their study is to be of the greatest service in accident prevention. These are (1) the number of accidents occurring; (2) the industries in which they occur; (3) the causes of the accidents; (4) the amount of exposure to hazard; (5) the severity of the accidents.

It will be well to consider with some care why these five items should be regarded as essential to any effective use of accident statistics for purposes of accident prevention.

(1) *Number of accidents.*—That the number of accidents should be recorded is obvious. The difficulty is that the States do not limit what shall be regarded as an accident in the same way. Reference to Table 2 will show that some States require reports of "tabulatable"² accidents. Some exclude those causing disability of one day or less, some those causing disability of two days or less, and some those causing disability of two weeks and less. This lack of uniformity regarding what shall be recorded greatly impairs the value of the record as an index of the precise conditions. It is not a matter of great concern to one attempting to formulate national statistics from these State records as to just what the definition shall be, but it is of great importance that it shall be universally adopted.

(2) *Industrial classification.*—It is evident that the gross total of accidents occurring in a State with varied industries leads nowhere. It is only when the matter is traced back to the industrial conditions under which the accidents occur that a beginning is made toward a knowledge of the proper remedial measures and their application. It is only necessary to consider Table 2 to see that it offers no suggestion whatever in the way of a program of prevention. When, however, as in Tables 3 to 27, the accidents in the various industries are separated, some hint is offered regarding the points where accident prevention effort is needed.

(3) *Causes of accidents.*—While an industrial classification gives some indication as to where efforts for prevention may be usefully applied, it does not in the least help in determining what the effort shall be. To gain some notion of what to do in the premises a classification by accident causes is needed. The number of States which have made some efforts at cause classification, as shown by Table 28, is evidence that there is some appreciation of its importance.

² A tabulatable accident, as defined by the International Association of Industrial Accident Boards and Commissions, is "an accident causing death, permanent disability, or temporary disability beyond the day or turn in which the accident occurred."

(4) *Exposure to hazard.*—The importance of knowing the exposure to hazard in connection with accidents is perhaps appreciated, but the difficulties of securing this information have thus far prevented attempts to secure the facts except in a few of the smaller States, such as Nevada and Oregon.

When it is observed that in Pennsylvania in a period of 6 years there have been 300,524 accidents in coal mining, while in the metals and metal products industry there have been 343,163 accidents, it becomes evident that the question regarding the relative hazard of these two industrial groups is still unanswered. The larger number in the metals and metal products industry may be only the natural result of a larger number employed rather than due to greater hazard. It is necessary to know how many employees were in each industrial group and something regarding the length of time during which these employees were subject to the dangers of their calling. Without this base to which to relate the number of accidents in both the industrial and the cause classification, the place most needing the application of accident prevention measures is not disclosed.

In this bulletin both accident frequency and severity rates are computed on the basis of 1,000 hours' exposure (or man hours worked), the base recommended by the committee of the International Association of Industrial Accident Boards and Commissions. Frequency rates are in most cases expressed in rates per thousand thousand (1,000,000) hours' exposure of the working force, while severity rates are expressed as days lost per thousand hours' exposure of the working force. Rates for the full-year worker (a hypothetical worker, supposed to work 10 hours a day for 300 days in the year), may be obtained by multiplying the rates given by 3.

(5) *Severity of accident.*—Information as to the amount of disability resulting from an accident is necessary because of the diversity of industry. Some industries naturally have a high proportion of severe injuries and others of minor injuries. Comparison of industries on the basis of frequency of accidents alone may give very misleading indications. In fact, high accident frequency rates are rather apt to go with low severity rates, and this fact should be made evident by the manner of statistical presentation. It may be said that the matter of severity can be studied fairly well for a given State by means of compensation costs, but the varying benefits and the other differences from State to State make nearly impossible a combination of the data in form which will be trustworthy.

In the absence of one or more of these elements of an adequate statistical study of accident prevention, the accident records from the States shown hereafter are less important than they would be if that information was available. They constitute, however, the most extensive compilation thus far made from the published reports of the States and as such have interest and value.

In Table 1 is shown the nature of the information which was obtainable from each of the several States and the source of the data appearing in this bulletin. For 42 States information was obtainable concerning fatal and nonfatal accidents; for 22 States a classification of accidents by industries; for 18 States a classification by cause of injury; for 12 States a classification by nature of injury; for 11 States a classification by location of injury; for 2 States the amount of exposure; and for 3 States the severity of accidents.

TABLE 1.—NATURE OF INFORMATION AS TO ACCIDENTS IN 1920 SECURED FROM THE SEVERAL STATES.

States reporting accidents by—							Source of information.
Number.	Indus-try.	Cause of injury.	Nature of injury.	Loca-tion of injury.	Expo-sure.	Sever-ity rates.	
(42)	(22)	(18)	(12)	(11)	(2)	(3)	
Ala.							Response to special request.
Ariz.	Ariz. ¹						Report of State Mine Inspector for 1920, p. 63.
Ark.	Ark.						Report of Bureau of Labor and Statistics for 1919-20, p. 50.
Calif.	Calif.	Calif.	Calif.	Calif.			Report of Industrial Accident Commission for 1920, p. 69.
Colo.							Report of Industrial Commission for 1921, p. 117.
Conn.							Response to special request.
Del.							Do.
Ga.							Do.
Idaho.	Idaho.	Idaho.	Idaho.	Idaho.			Report of Industrial Accident Board for 1920, p. 35 et seq.
Ill.	Ill.	Ill.	Ill.	Ill.			Report of Industrial Commission for 1920, p. 14 et seq.
Ind.	Ind.	Ind.	Ind.	Ind.			Report of Industrial Board for 1919-20, p. 4 et seq.
Iowa.							Response to special request.
Kans.	Kans.						Report of Court of Industrial Relations for 1920, p. 34.
Ky.		Ky.	Ky.	Ky.			Report of Workmen's Compensation Board for 1919-20, p. 17 et seq.
Me.							Response to special request.
Md.	Md.	Md.	Md.	Md.			Report of Industrial Accident Commission for 1920, p. 15.
Mass.	Mass.	Mass.	Mass.	Mass.			Report of Industrial Accident Board for 1920-21, p. 49.
Mich.							Response to special request.
Minn.	Minn.	Minn.	Minn.	Minn.			Report of Department of Labor and Industries for 1919-1920, p. 26 et seq.
Mont.	Mont.		Mont.				Report of Industrial Accident Board for 1920, p. 232 et seq.
Nebr.							Response to special request.
Nev.	Nev.				Nev.	Nev.	Report of Industrial Commission for 1920, p. 22.
N. H.							Response to special request.
N. J.	N. J.	N. J.					Report of Department of Labor for 1920, p. 110 et seq.
N. Mex.	N. Mex. ¹						Report of State Mine Inspector for 1920.
N. Y.							Response to special request.
N. Dak.		N. Dak.					Report of Workmen's Compensation Bureau for 1920-21, p. 9.
Ohio.		Ohio.					Ohio General Statutes, 1921, p. 293.
Okla.	Okla.			Okla.			Report of Industrial Commission for 1921, p. 16.
Oreg.	Oreg.	Oreg.			Oreg.	Oreg.	Report of Industrial Accident Commission for 1920, p. 6.
Pa.	Pa.	Pa.	Pa.	Pa.			Advance sheets of tables for 1920; Monthly Bulletin of Department of Labor and Industries, November, 1922, p. 35.
R. I.							Response to special request.
S. Dak.	S. Dak.						Report of Industrial Commission for 1920.
Tenn.	Tenn.	Tenn.	Tenn.				Report of Bureau of Workshop and Factory Inspection for 1921, p. 95 et seq.
Tex.							Response to special request.
Utah.							Report of Industrial Commission for 1920.
Va.							Response to special request.
Vt.		Vt.					Report of Commissioner of Industries for 1920, p. 49.
Wash.	Wash.	Wash.					Report of Department of Labor and Industries for 1921-22.
W. Va.							Response to special request.
Wis.	Wis.	Wis.				Wis.	Wisconsin Safety Review, October, 1921, p. 14.
Wyo.	Wyo.	Wyo.	Wyo.	Wyo.			Report of Workmen's Compensation Department for 1920, p. 32.

¹ Mines only.

STATE ACCIDENT RECORDS FOR 1917 TO 1921.

In Table 2 are shown the number of fatal and nonfatal accidents from 1917 to 1921 recorded by the various States and by the United States Employees' Compensation Commission.

TABLE 2.—NUMBER OF FATAL AND NONFATAL ACCIDENTS AS REPORTED BY THE SEVERAL STATES, 1917 TO 1921.

State.	1917		1918		1919		1920		1921		Scope of data.
	Fatal.	Nonfatal.	Fatal.	Nonfatal.	Fatal.	Nonfatal.	Fatal.	Nonfatal.	Fatal.	Nonfatal.	
Alabama.....	108	31	110	36	.....	.....	135	7,144	115	5,500	Only fatal and serious accidents in coal mines reported prior to Jan. 1, 1920, when compensation law went into effect. Calendar year.
Arizona ¹	82	998	93	1,261	62	1,127	53	958	22	509	Compensation law makes no provision for reporting accidents. Fiscal year, ends Nov. 30.
Arkansas.....	.....	.....	14	150	(²)	(²)	16	1,405	(²)	(²)	No compensation act. Mine accidents required to be reported. Fiscal year.
California ²	626	59,055	706	57,014	586	57,991	592	69,813	550	124,979	Accidents involving loss of time or medical aid reported by all employers. Act compulsory. Calendar year.
Colorado.....	300	12,480	202	14,730	201	11,157	179	14,100	151	13,753	Accidents reported by employers under the act. Act elective. Fiscal year, ends Nov. 30.
Connecticut.....	.....	⁴ 46,935	.....	⁴ 43,188	.....	⁴ 42,513	.....	⁴ 38,764	96	22,800	Accidents of 1 day's disability reported by employers under act. Law elective.
Delaware.....	(²)	(²)	41	6,107	34	4,853	36	2,611	18	3,882	Accidents reported by employers under act. Law elective. Calendar year.
Florida.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	No provision for reporting accidents.
Georgia.....	.....	.....	.....	.....	.....	.....	.....	.....	82	11,696	No provision for reporting accidents until passage of workmen's compensation law, which became effective in 1921.
Idaho.....	¹ 21	¹ 854	⁶ 64	⁶ 3,785	51	3,836	83	5,367	63	4,564	Accidents of more than 1 day's disability. 1919 figures are closed cases only. Fiscal year, ends Oct. 30.
Illinois.....	492	36,268	629	37,618	535	37,754	597	49,958	498	43,024	Accidents of more than 1 week's disability. Law compulsory as to extrahazardous occupations enumerated. Calendar year.
Indiana.....	305	42,148	373	37,147	268	34,964	291	42,703	263	34,133	Accidents of more than 1 day's disability reported by employers under act. Law compulsory as to mines, elective as to other employments. Fiscal year, ends Sept. 30.
Iowa.....	159	24,520	187	15,420	181	10,926	154	14,283	113	14,839	1917 figures supposed to include all accidents reported by employers under act. 1918 and 1919 accidents of more than 1 day's disability reported by employers under act. Law elective. Fiscal year, ends June 30.
Kansas.....	83	6,371	93	6,342	104	6,322	118	6,891	71	6,240	Accidents of more than 1 day's disability reported by employers under act. Law elective.
Kentucky.....	.....	⁶ 12,665	96	13,557	118	13,810	493	15,662	122	16,687	Accidents of more than 1 day's disability reported by employers under act. Law elective. Fiscal year, ends June 30.

¹ Mines only.

² Not reported.

³ Figures for nonfatal cases in California, 1917 to 1920, are for tabulatable accidents, while for 1921 they include all accidents reported.

⁴ Includes fatal accidents, the number of which is not reported.

⁵ Covers 10 months only.

⁶ Includes fatal accidents, the number of which is not reported. Covers claims filed for 11 months only.

TABLE 2.—NUMBER OF FATAL AND NONFATAL ACCIDENTS AS REPORTED BY THE SEVERAL STATES, 1917 TO 1921—Concluded.

State.	1917		1918		1919		1920		1921		Scope of data.
	Fatal.	Nonfatal.	Fatal.	Nonfatal.	Fatal.	Nonfatal.	Fatal.	Nonfatal.	Fatal.	Nonfatal.	
Louisiana.....	(²)	⁷ 819	⁷ 1	⁷ 980	.....	⁷ 876	⁷ 1	(²)	.....	.....	Accidents of more than 2 weeks' disability in establishments where women and children are employed. Compensation law carries no provision for reporting accidents. Calendar year.
Maine.....	63	14,738	83	16,557	52	18,666	60	18,463	49	12,778	Accidents occurring during year reported by employers under act. Law elective. Calendar year.
Maryland.....	⁸ 131	37,303	⁸ 163	42,407	⁸ 183	46,692	⁸ 153	53,525	⁸ 116	36,896	Accidents causing disability reported by employers under act. Law compulsory. Fiscal year, ends Oct. 31.
Massachusetts.....	481	78,308	438	77,067	356	66,884	376	65,112	296	53,017	Tabulatable accidents. Fiscal year, ends June 30.
Michigan.....	386	112,477	320	256,309	256	231,421	313	227,045	⁹ 266	⁹ 100,176	Accidents reported by all employers. Law elective. Calendar year.
Minnesota.....	183	30,926	251	29,716	215	27,068	201	32,659	124	29,204	Tabulatable accidents reported by employers under act. Law elective. Fiscal year, ends June 30.
Mississippi.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	No provision for reporting accidents.
Missouri.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	No statistics published. None received in response to letter of inquiry. Compensation law nullified by popular referendum in 1920.
Montana.....	307	8,018	124	5,697	122	5,353	94	4,820	83	3,421	Tabulatable accidents reported by employers under act. Law elective. Fiscal year, ends June 30.
Nebraska.....	15	13,278	13	7,053	28	11,245	50	13,626	30	11,326	Accidents causing disability or requiring medical aid reported by employers under act. Law elective. Calendar year.
Nevada.....	52	1,958	39	1,960	35	1,177	33	1,143	15	3,051	Tabulatable accidents reported by employers under act. Law elective. Fiscal year, ends June 30.
New Hampshire....	9	459	10	759	.....	.....	40	3,385	10	1,521	Accidents resulting in 2 weeks' disability or more reported by employers under act. Law elective. Fiscal year, ends Aug. 31.
New Jersey.....	361	12,382	¹⁰ 185	¹⁰ 37,003	524	30,728	285	28,556	282	27,754	Accidents of more than 2 weeks' disability. Law elective. Commission has requested that all tabulatable accidents be reported, which probably accounts for increase in 1918. Fiscal year, ends June 30.
New Mexico.....	.....	.....	¹ 28	¹ 543	¹ 21	(²)	¹ 32	(²)	¹ 16	(²)	Only mine accidents reported. Compensation act in effect since June, 1917, but no provision for reporting accidents except to mine inspector. Fiscal year, ends Oct. 31.
New York.....	1,570	311,836	1,504	285,367	1,815	286,629	1,236	344,436	1,170	292,781	Tabulatable accidents reported by employers under act. Law compulsory. Fiscal year, ends June 30.
North Carolina.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Law provides for reporting of mine accidents only. No report has been received.
North Dakota.....	.....	.....	.....	.....	.....	.....	4	720	.....	1,331	Accidents not reported until July 1, 1919, when compensation law went into effect.
Ohio.....	855	158,786	956	161,253	870	151,401	764	182,206	649	111,626	Number of claims filed. Total figure not tabulated. Fiscal year, ends June 30.
Oklahoma.....	141	15,027	195	19,723	.....	.....	130	22,584	85	22,864	Accidents causing disability reported by employers under act. Law compulsory. Fiscal year, ends Aug. 31.

Oregon.....	90	12,044	103	12,638	147	14,333	144	13,275	138	20,318	Tabulatable accidents. Law elective. Figures for 1918 are closed cases only. Fiscal year, ends June 30.
Pennsylvania.....	3,072	224,808	3,403	181,441	2,569	149,975	2,528	172,451	1,924	138,273	Accidents of more than 2 days' disability reported by employers under act. Law elective. Calendar year.
Rhode Island.....	27	3,053	49	3,133	28	2,666	28	2,951	24	2,952	Industrial commission has issued no report. Data cover factories only. Calendar year.
South Carolina.....											No provision for accident reporting.
South Dakota.....	17	1,583	20	1,750	23	2,228	21	2,230	23	2,701	Accidents reported by employers under act. Law elective. Fiscal year, ends June 30.
Tennessee.....	26	1,465	49	1,613	30	1,190	109	17,455	96	17,093	Accidents causing injury and death reported to factory inspector. 1919 figures estimated. Calendar year.
Texas.....			223	52,502			400	65,600	308	94,564	Accidents of more than 1 day's disability reported by employers under act. Law elective. Fiscal year, ends Aug. 31.
Utah.....	(²)	(²)	90	11,782	73	8,816	99	10,084	94	5,612	Accidents causing disability or requiring medical aid reported by employers under act. Law compulsory. Fiscal year, ends June 30. No reports prior to July 1, 1918.
Vermont.....	32	(²)	49	7,160	28	6,258	32	8,043	27	6,331	Accidents of more than 1 day's disability or requiring medical aid reported by employers under the act. Law elective. Fiscal year, ends June 30.
Virginia.....	163	1,512	141	1,846	144	10,776	172	12,151	133	11,347	1919 figures represent accidents of more than 1 day's disability reported by employers under act (law elective) for 9 months' period ending Sept. 30.
Washington.....	320	22,156	414	26,892	368	21,905	369	25,924	287	20,016	Accidents causing disability reported by employers under the act. Law compulsory. Fiscal year, ends Sept. 30.
West Virginia.....	488	22,903	547	23,832	(²)	(²)	(¹²)	(¹²)	429	20,398	Accidents reported by employers under the act. Law elective. Fiscal year, ends June 30.
Wisconsin.....	219	20,341	163	19,198	244	18,204	171	18,270	181	18,806	Accidents of more than 7 days' disability required to be reported. Law elective. Statistics of fatalities are number of claims for compensation. Fiscal year, ends June 30.
Wyoming.....	137	1,726	24	571	36	605	43	776	51	2,042	Claims allowed. Calendar year.
United States Compensation Commission.....	227	14,849	438	23,680	499	25,171	427	19,653	324	18,066	Calendar year.
Total.....	¹⁶ 11,338	¹⁴ 1,363,088	¹⁷ 12,531	¹⁸ 1,545,787	¹⁷ 10,806	¹⁸ 1,365,520	¹⁷ 11,052	¹⁸ 1,636,837	9,394	1,382,871	

¹ Mines only.² Not reported.³ Figures for New Orleans Parish.⁴ Number of claims filed.⁵ Estimated.⁶ Covers 8 months only.⁷ Cases less than 8 days' disability not reported.⁸ Records destroyed by fire.⁹ Covers 15 months.¹⁰ Includes cases reported from Sept. 7, 1916, to Dec. 31, 1916.¹¹ Fatal cases in Connecticut and Kentucky are included under nonfatal cases, not being reported separately.¹² Includes fatal accidents in Connecticut and Kentucky, the number of which is not reported.¹³ Fatal cases in Connecticut are included under nonfatal cases, not being reported separately.¹⁴ Includes fatal cases in Connecticut, the number of which is not reported.

The notes in the above table on the scope of the data indicate the fact, to which reference has already been made, that the same rule are not in force in each jurisdiction. It should also be remarked that most of the States exclude from the operation of the workmen's compensation act agricultural labor and domestic service, and a large proportion of them do not include steam railways. This latter exclusion is of less importance in view of the fact that the steam railways are under the jurisdiction of the Interstate Commerce Commission, which gathers detailed information regarding accidents in connection with their operation.

While the number of nonfatal accidents is for the reason mentioned considerably short of what it would be if all the States recorded all "tabulatable" accidents, the record of fatalities is more complete or at least more uniform from State to State. It is therefore safer to base such conclusions as may be offered on fatalities rather than on the nonfatal accidents.

Of the years included in the table the year with the highest number of fatalities is 1918, with 12,531 recorded deaths. It is probable that this represents both greater hazard and intensified industrial activity, as simply a greater number working will, if the hazard is not reduced, give a greater number of casualties. It is known from other sources that a larger number of people were engaged in industry during 1918 than in any other year and that this year represented the peak of industrial activity in many respects. The rather steady decline in number of deaths from 1918 onward certainly reflects the influences of two factors, namely, a declining industrial activity and a renewal of accident prevention effort which had been somewhat lessened by the war.

When the individual States are considered, Pennsylvania has in each year the highest fatality, New York having the next highest. This, beyond question, is largely due to the extent of their industries rather than to extraordinary hazard. The fact that in 1921 Pennsylvania had a larger fatality (1,924 deaths) than New York (1,170 deaths) is attributable to the preponderance in Pennsylvania of such industries as mining and the basic processes of iron and steel. Ohio, with 649 deaths and California, with 550 deaths, are next in order. Ohio has extensive mining operations and is a great manufacturing State. California also has mining on a large scale, which contributes to its casualty list; it also includes accidents in its extensive agricultural industry, which industry most States exclude. In West Virginia, where mining is a very important industry, the number of fatalities (429) is considerable.

STATE ACCIDENT RECORDS FOR 1920.

Accident data for 1920 for individual States have been taken or compiled from the State reports and are here presented in a series of tables having a fairly uniform industrial classification, the classification used being substantially that used in Massachusetts and Pennsylvania. It is sufficiently detailed to give, if the exposure were known, a very good idea of the relative hazards. If these groupings were used by the different States, each group being amplified to the extent desired by the particular State but presenting a total, it would greatly simplify the task of bringing the data together for such a pur-

pose as the present compilation. In some State reports the number of accidents classified by industry is the number of compensation claims filed or closed rather than the number of accidents reported. As the record of fatalities is more uniform than that for other items, as stated above, it will be made the basis of most of the comment.

ARKANSAS.

The notable item in Table 3, showing the fatal and nonfatal accidents in Arkansas reported for 1920, is that the largest number of deaths (11) was in the lumber and its remanufacture industry. It is probable that agriculture was responsible for a considerable number of deaths, but agriculture is not included under the compensation law.

TABLE 3.—NUMBER OF ACCIDENTS IN ARKANSAS, 1920, BY INDUSTRIES.

Industry.	Number of accidents.		
	Fatal.	Non-fatal.	Total.
Clay, glass, and stone.....		3	3
Food.....		23	23
Lumber and its remanufacture.....	11	1,149	1,160
Mercantile.....		5	5
Mines (not coal).....	2	63	65
Metals and products.....		13	13
Printing and publishing.....		6	6
Public service.....	1	12	13
Textiles.....		2	2
All other.....	2	128	130
Total.....	16	1,404	1,420

CALIFORNIA.

Public service, which in California includes the railways, had in that State the greatest number of fatalities in 1920 (122). Next comes construction (63), then lumber (60), and mines (60), with agriculture just behind (59).

TABLE 4.—NUMBER OF ACCIDENTS IN CALIFORNIA, 1920, BY INDUSTRIES.

Industry.	Accidents resulting in—			Total accidents.
	Death.	Perma- nent dis- ability.	Tempo- rary dis- ability.	
Agriculture.....	59	125	4,102	4,286
Chemicals.....	11	43	1,964	2,018
Clay, glass, and stone.....	7	23	705	735
Clothing.....		6	227	233
Construction.....	63	261	8,003	8,327
Food products.....	17	103	5,154	5,274
Laundries.....		21	362	383
Leather and rubber.....	1	14	462	477
Lumber.....	60	268	4,649	4,977
Metals and metal products.....	14	237	6,880	7,131
Mines (not coal) and quarries.....	60	170	4,491	4,721
Paper and printing.....	4	54	808	866
Public service.....	122	143	8,867	9,132
Shipbuilding.....	26	144	4,118	4,288
Textiles.....	1	4	132	137
All other.....	147	263	16,960	17,370
Total.....	592	1,929	67,884	70,405

IDAHO.

In Idaho the lumber industry, with 43 deaths, heads the list of industries in fatalities, as shown in Table 5.

TABLE 5.—NUMBER OF ACCIDENTS IN IDAHO, YEAR ENDING OCTOBER 31, 1920, BY INDUSTRIES.

Industry.	Accidents resulting in—			Total accidents.
	Death.	Perma- nent dis- ability.	Tempo- rary dis- ability.	
Agriculture and stock raising.....	1	6	113	120
Construction.....	12	36	665	713
Lumber.....	43	96	1,453	1,592
Mines.....	13	34	1,163	1,210
Mercantile.....	1	19	471	491
Unclassified.....	13	64	883	960
Total.....	83	255	4,748	5,086

¹ Compensation claims allowed.

ILLINOIS.

Illinois is one of the States of large industrial importance with extremely varied occupations. The mines had the greatest number of deaths in 1920 (171). The metals and metal products industry came next with 86 deaths, while public service and construction each had 68. The small number reported for agriculture is due to the fact that accidents are reported only for those agricultural employers who elect to come under the compensation act.

TABLE 6.—NUMBER OF ACCIDENTS ¹ IN ILLINOIS, 1920, BY INDUSTRIES.

Industry.	Accidents resulting in—			Total accidents.
	Death.	Perma- nent dis- ability.	Tempo- rary dis- ability.	
Agriculture.....	8	28	245	281
Chemicals.....	25	155	1,144	1,324
Clay, glass, and stone.....	9	79	828	916
Clothing.....	1	50	530	581
Construction.....	68	455	3,190	3,713
Food products.....	29	316	2,845	3,190
Leather and rubber.....	3	83	420	506
Lumber.....	24	379	1,579	1,982
Mercantile.....	5	65	895	965
Metals and metal products.....	86	2,085	11,710	13,881
Mines, coal.....	171	3,680	9,398	13,249
Mines (not coal) and quarries.....	12	41	384	437
Municipalities.....	17	10	204	231
Paper and paper products.....	4	95	519	618
Printing and publishing.....	2	109	594	705
Public service.....	68	246	2,357	2,671
Textiles.....	7	39	253	299
Unclassified.....	58	311	4,667	5,036
Total.....	597	8,226	41,762	50,585

¹ Compensable accidents.

INDIANA.

It is not possible to separate the accidents reported in the Indiana records into fatal and nonfatal accidents. An extremely detailed classification of industry is used, from which it is difficult to reduce the record to the simpler form used in this bulletin. In 1921 the metals and metal products industry had the most serious casualty record, with coal mines second, public service third, and the lumber industry fourth.

TABLE 7.—NUMBER OF ACCIDENTS IN INDIANA, 1920 AND 1921, BY INDUSTRIES.

Industry.	Year ending September 30—		Industry.	Year ending September 30—	
	1920	1921		1920	1921
Agriculture.....	189	148	Mines, coal.....	4,222	4,851
Chemicals.....	156	91	Mines (not coal) and quarries.....	477	698
Clay, glass, and stone.....	1,614	1,253	Municipal.....	32	31
Clothing.....	135	196	Paper products.....	682	589
Construction.....	2,731	3,056	Printing.....	248	175
Food.....	2,452	2,112	Public service.....	4,843	4,248
Leather and rubber.....	454	427	Textiles.....	154	136
Lumber.....	3,355	2,274	Unclassified.....	2,973	3,156
Mercantile.....	1,176	1,272			
Metal products.....	17,101	9,683	Total.....	42,994	34,396

KANSAS.

The accident data for Kansas here shown cover two years, 1920 and 1921. Public service led in the number of fatalities with 57 and 24, respectively, mines following with 19 and 23. Agriculture, which would doubtless be of much interest, is not represented.

TABLE 8.—NUMBER OF ACCIDENTS IN KANSAS, 1920 AND 1921, BY INDUSTRIES.

Industry.	Accidents resulting in—						Total accidents.	
	Death.		Permanent disability.		Temporary disability.		1920	1921
	1920	1921	1920	1921	1920	1921		
Clay, glass, and stone.....	1	1	3	1	99	82	103	84
Food products.....	5	5	25	11	964	908	994	924
Lumber.....	1	1	18	3	29	28	47	32
Metals and metal products.....	4	3	16	7	958	509	978	519
Mines, coal.....	19	23	18	7	836	810	873	840
Mines (not coal) and quarries.....	2	6	6	2	227	57	235	57
Oil and gas.....	13	7	24	19	1,205	1,245	1,242	1,271
Public service.....	57	24	13	24	1,844	1,609	1,944	1,657
Unclassified.....	17	7	14	21	562	899	593	927
Total.....	118	71	167	93	6,724	6,147	7,009	6,311

MARYLAND.

In the records of Maryland shipbuilding is included with construction, with the result that the fatalities in that group in 1920 (56) were considerably in excess of any other group. The metals and metal products industry came next (30) and public service (20) third.

TABLE 9.—NUMBER OF ACCIDENTS¹ IN MARYLAND, YEAR ENDING OCTOBER 31, 1920, BY INDUSTRIES.

Industry.	Number of accidents.		
	Fatal.	Nonfatal.	Total.
Chemicals.....	10	62	72
Clay, glass, and stone.....	3	441	444
Clothing.....	12	29	41
Construction ²	56	2,438	2,494
Food products.....		284	284
Leather and rubber.....		210	210
Lumber.....	2	100	102
Metals and metal products.....	30	1,188	1,218
Paper and paper products.....	4	204	208
Printing and publishing.....	6	198	204
Public service.....	20	510	530
Textiles.....		126	126
Unclassified.....	10	751	761
Total.....	153	6,541	6,694

¹ Compensation claims allowed.² Includes shipbuilding.

MASSACHUSETTS.

In the report from which Table 10 is drawn the main industrial divisions are subdivided in great detail; for instance, "textiles" is subdivided as follows: Carpet mills, cotton mills, dyeing, hemp and jute, knitting, lace, linen, print works, cordage, sails, silk mills, woolen mills, and unclassified. In Table 10 the number of accidents resulting in death and permanent and temporary disability are shown for the main industrial divisions only:

TABLE 10.—NUMBER OF ACCIDENTS IN MASSACHUSETTS, 1920, BY INDUSTRIES.

Industry.	Accidents resulting in—			Total accidents.
	Death.	Perma- nent dis- ability.	Tempo- rary dis- ability.	
Agriculture.....	2	3	191	196
Chemicals.....	8	13	760	781
Clay, glass, and stone.....	3	11	392	406
Clothing.....	1	3	312	316
Construction.....	43	98	4,891	5,032
Food.....	7	49	2,023	2,079
Leather.....	12	148	4,504	4,664
Lumber.....	4	118	2,052	2,174
Mercantile.....	36	82	5,997	6,115
Metals and products.....	36	436	13,179	13,657
Mines and quarries.....	3	9	172	184
Paper.....	8	47	1,986	2,041
Printing.....	1	31	686	718
Public service.....	135	62	8,125	8,322
Textiles.....	37	288	10,921	11,246
Unclassified.....	40	223	7,300	7,563
Total.....	376	1,621	63,491	65,488

The public service group, which includes steam railways, had the heaviest fatality in 1920 (135); construction (43), textiles (37), metals and products (36), and mercantile concerns (36) following in order. These figures are less suggestive from the standpoint of accident prevention than they should be, because of the lack of data regarding

exposure. So far as number of fatalities is concerned, the textiles group (37) and the metals and metal products group (36) are almost on an equality. It is known from other sources that the hazard is by no means equal, but what the relative hazard may be can not be discovered from these figures. However, Massachusetts has also tabulated its accident experience on the basis of working days lost, and from this tabulation it appears that the metals and metal products group had losses equivalent to 786,174 days, while textiles had losses equivalent to 684,526 days. This gives an idea of the relative severity, but the factor of exposure still is needed to make the indication precise.

Table 11 shows the percentage of accidents due to specified causes and of total days lost from each cause.

TABLE 11.—PER CENT OF ACCIDENTS IN MASSACHUSETTS IN 1920 DUE TO EACH SPECIFIED CAUSE AND OF DAYS LOST.

Accident cause.	Per cent.	
	Acci- dents.	Days lost.
Machinery.....	23.4	29.1
Vehicles.....	6.3	21.3
Explosives and hot substances.....	4.6	7.7
Falls of persons.....	14.0	14.1
Falling objects not handled.....	3.7	4.2
Handling objects.....	29.2	13.0
Handling tools.....	7.3	3.6
Stepping on or striking objects.....	6.0	1.7
Other causes.....	5.5	5.3
Total.....	100.0	100.0

A comparison of these percentages will at once disclose that the frequency and severity of accidents do not move together. The cause group "Vehicles" is a conspicuous instance. It had only 6.3 per cent of the accidents but accounted for 21.3 per cent of the days lost. Handling, however, in the two forms specified had 36.5 per cent of the accidents with but 16.6 per cent of the days lost. The losses are certainly the better index of where prevention is most needed.

MINNESOTA.

The importance of mining in Minnesota is indicated by the number of fatalities therein (56 in 1920), lumber coming second (34 deaths), and construction third (23 deaths). The small number of deaths (13) in the food products industry in this great milling State may indicate that the industry is comparatively nonhazardous or may mean that the processes of milling are so largely automatic that the number of employees is small but that they are individually exposed to somewhat high hazard.

39554°—23—Bull. 339—2

TABLE 12.—NUMBER OF ACCIDENTS IN MINNESOTA, YEAR ENDING JUNE 30, 1920, BY INDUSTRIES.

Industry.	Accidents resulting in—			Total accidents.
	Death.	Perma- nent dis- ability.	Tempo- rary dis- ability.	
Agriculture.....	1	1	43	45
Clothing.....		1	37	38
Construction.....	23	120	1,447	1,589
Chemicals.....	1	14	123	138
Clay.....	1	28	256	285
Food.....	13	154	1,444	1,611
Leather.....	1	21	112	134
Lumber.....	34	214	1,223	1,471
Mercantile.....	9	52	653	714
Metals.....	13	195	1,430	1,638
Mines (not coal) and quarries.....	56	136	2,001	2,193
Municipal.....	6	19	121	206
Paper.....	3	26	217	246
Printing.....		18	115	133
Public service.....	15	27	427	469
Textiles.....		16	99	115
Unclassified.....	25	141	1,546	1,713
Total.....	201	1,183	11,354	12,738

MONTANA.

The marked preponderance of mining among Montana industries is indicated by the fact that the fatalities (558) were, during the five-year period, considerably more than two-thirds of all recorded in the State. The metals and products (66 deaths), construction (41 deaths), and lumber (36 deaths) groups follow in order.

TABLE 13.—NUMBER OF ACCIDENTS IN MONTANA FOR 5-YEAR PERIOD JULY 1, 1915, TO JUNE 30, 1920, BY INDUSTRIES.

Industry.	Accidents resulting in—			Total accidents.
	Death.	Perma- nent dis- ability.	Tempo- rary dis- ability.	
Clay and stone.....	2	1	65	68
Construction.....	41	59	2,036	2,136
Food.....	10	28	1,173	1,211
Leather.....			1	1
Lumber.....	36	82	1,629	1,747
Mercantile.....	1	10	304	315
Metals and products.....	66	109	2,960	3,135
Mines, coal.....	61	76	1,832	1,969
Mines (not coal) and quarries.....	497	287	17,926	18,710
Municipal.....	1		108	109
Printing and publishing.....		5	125	131
Public service.....	31	19	770	820
Textiles.....			7	7
Unclassified.....	35	22	898	955
Total.....	782	698	29,834	31,314

NEVADA.

Nevada is notable as one of two States which has undertaken to determine exposure, as expressed by "full-year workers." The other State which has made a similar effort is Oregon. The exposure is not sufficient in either case to warrant accepting the rates as typical, but a comparison of them is interesting and suggestive.

Of the industries which have hitherto been covered for any considerable period, erection of structural steel has registered the highest severity rate (25.9 days per 1,000 hours exposure, in 1920). For Nevada lumber manufacture, including lumbering, the severity rate in that year was 28.0 days. Metal mines had the largest fatality (19 deaths) but not the highest severity rate (15.5 days). This further emphasizes the necessity of knowing the amount of exposure, such as Nevada has secured, if precise relations are to be understood.

TABLE 14.—NUMBER OF ACCIDENTS IN NEVADA, 1920, NUMBER OF FULL-YEAR WORKERS, AND ACCIDENT FREQUENCY AND SEVERITY RATES, BY INDUSTRIES

Industry.	Full-year workers.	Accidents resulting in—			Total accidents.	Accident frequency rates (per 1,000,000 hours' exposure).	Accident severity rates (per 1,000 hours' exposure).
		Death.	Per- manent dis- ability.	Tem- porary dis- ability.			
Construction.....	73	.....	4	14	18	82	14.3
Food.....	186	1	2	30	33	59	13.3
Lumber.....	273	3	5	46	54	66	28.0
Metals.....	2,381	3	16	.....	160	22	5.1
Mines (not coal).....	3,736	19	64	.....	769	69	15.5
Municipal.....	2,119	4	11	43	58	9	5.3
Public service.....	738	2	2	37	41	18	11.7
Unclassified.....	1,104	1	119	860	43	.....	.....
Total.....	10,610	33	113	1,030	1,176	37	9.7

NEW JERSEY.

The industrial conditions in New Jersey were much more uniform than those in most of the States in the two years covered by Table 15 (1920 and 1921). The fatalities in 1920 and 1921 were 285 and 282, respectively, while the total accidents were 28,841 and 28,036, respectively.

The distribution is also remarkably uniform. Among the industry groups chemicals lead in fatalities (47), with metals (38), construction (31), and shipbuilding (25) following.

TABLE 15.—NUMBER OF ACCIDENTS IN NEW JERSEY, YEARS ENDING JUNE 30, 1920 AND 1921, BY INDUSTRIES.

Industry.	Fatal accidents.		Nonfatal accidents.		Total accidents	
	1920	1921	1920	1921	1920	1921
Chemicals.....	47	33	1,708	1,326	1,755	1,359
Clay.....	6	5	414	349	420	354
Clothing.....	2	1	93	343	95	349
Construction.....	31	44	5,965	6,951	5,996	6,995
Food.....	16	10	381	529	397	539
Leather.....	12	8	586	676	598	684
Metals.....	38	42	7,231	5,226	7,269	5,268
Mines (not coal) and quarries.....	1	11	83	215	84	226
Paper.....	5		81	154	86	154
Printing.....			65	67	65	67
Shipbuilding.....	25	23	2,792	1,997	2,817	2,020
Textiles.....	8	9	269	1,092	277	1,101
Unclassified.....	94	96	8,888	8,824	8,982	8,920
Total.....	285	282	23,556	27,754	28,841	28,036

OKLAHOMA.

In Oklahoma in 1920 the oil and gas industry lead in fatal cases (36), coal mines (25) and metal mines (15) being next in order. As in most States, construction had a notable amount of fatal injury (18 cases).

TABLE 16.—NUMBER OF ACCIDENTS IN OKLAHOMA, YEAR ENDING SEPTEMBER 1, 1920, BY INDUSTRIES.

Industry.	Accidents resulting in—			Total accidents
	Death.	Perma- nent dis- ability.	Tempo- rary dis- ability.	
Clay.....		5	612	617
Construction.....	28	35	1,567	1,620
Food.....		8	605	613
Lumber.....	3	18	1,074	1,095
Mercantile.....	7	19	1,322	1,348
Metals and products.....	6	23	1,823	1,852
Mines, coal.....	25	42	1,045	1,112
Mines (not coal) and quarries.....	15	110	3,809	3,934
Oil and gas.....	36	166	7,619	7,821
Printing and publishing.....		3	110	113
Public service.....	5	9	732	746
Unclassified.....	15	63	1,765	1,843
Total.....	130	501	22,083	22,714

OREGON.

Oregon shares with Nevada the distinction of having assembled the facts regarding exposure and formulating some significant rates on the basis of them. A comparison of the frequency and severity rates for 1920 will emphasize again the fact that without both of these rates it is impossible to understand the situation in any given industry.

Of the 71,166 full-year workers listed by the industrial commission more than one-third (29,584) were engaged in logging and lumbering operations. Of these logging had a fatality rate in 1920 of 6.93 cases per 1,000 full-year workers. This may be compared with 3.62 in coal mining for the whole country. The severity rate (days lost per

1,000 hours' exposure) for Oregon logging operations was 21.56, which may be compared with 25.9 in the erection of structural steel in the same year.

The operation of Oregon logging railways involved in 1920 a fatality rate of 6.30 per 1,000 full-year workers as against 1.76 for railway trainmen the country over. However, yard brakemen on all steam roads had a rate of 6.67.

Construction had a severity rate (per 1,000 hours' exposure) of 9.11 days. This is about the same as that found elsewhere when it has been possible to calculate rates.

TABLE 17.—NUMBER OF ACCIDENTS IN OREGON, 1920, BY INDUSTRIES.

Industry.	Full-year workers.	Accidents resulting in—				Rates for industrial groups of 2,000 or over.	
		Death.	Perma- nent dis- ability.	Tempo- rary dis- ability.	Total.	Frequency (per 1,000,000 hours' exposure).	Severity (per 1,000 hours' exposure).
Agriculture.....	1,681	.....	13	122	135	.....	.....
Chemicals.....	165	.....	1	27	28	.....	.....
Clay, glass, etc.....	460	.....	4	60	64	.....	.....
Clothing.....	319	.....	1	21	22	.....	.....
Construction.....	10,068	16	112	1,670	1,798	59.53	9.11
Food and allied products.....	4,678	1	28	703	732	52.16	2.94
Leather and rubber.....	255	.....	4	25	29	.....	.....
Lumber and its remanufacture.....	17,524	24	330	3,835	4,190	72.72	10.36
Logging.....	9,520	66	144	1,979	2,189	76.65	21.56
Logging railways.....	2,540	16	34	247	297	38.97	20.24
Metals and metal products.....	4,129	2	45	1,022	1,069	86.31	5.67
Mercantile.....	1,726	.....	6	89	95	.....	.....
Mines, coal.....	65	.....	2	22	24	.....	.....
Mines (not coal) and quarries.....	918	3	20	214	237	.....	.....
Municipalities.....	311	.....	3	19	22	.....	.....
Paper and printing.....	2,389	.....	17	401	418	58.33	2.30
Public service.....	1,507	5	4	142	151	.....	.....
Shipbuilding.....	4,223	6	47	1,009	1,062	83.82	6.09
Textiles.....	1,263	.....	6	114	120	.....	.....
Unclassified.....	7,425	5	37	665	707	.....	.....
Total.....	71,166	144	858	12,387	13,389	.....	.....

PENNSYLVANIA.

The industries of Pennsylvania are so varied and extensive that any presentation of them is important and impressive, but in addition the Pennsylvania report for 1920 presents the relation of the industries to accident occurrence in a more elaborate fashion than has ever been attempted hitherto.

In Table 18 are shown fatal and nonfatal accidents for 1920 and 1921. The size of the coal-mining interests of the State are seen in the fact that of 2,271 deaths in such mines in 1920 there were 1,019 in the mines of Pennsylvania, nearly one-half of all. Public service, which includes the steam and electric railways of the State, is second in fatalities, having had 535 deaths. Metals and products with 363 deaths and construction with 218 deaths are important industrial groups.

TABLE 18.—NUMBER OF ACCIDENTS IN PENNSYLVANIA, 1920 AND 1921, BY INDUSTRIES.

Industry.	Fatal accidents.		Nonfatal accidents.	
	1920	1921	1920	1921
Chemicals.....	62	72	2,571	2,223
Clay, glass, and stone.....	58	36	5,678	4,092
Clothing.....	8	5	1,203	1,305
Construction.....	218	163	12,702	10,667
Food products.....	32	22	3,286	3,527
Leather and rubber.....	15	7	1,915	1,559
Lumber and its remanufacture.....	34	25	3,559	2,757
Mercantile.....	27	38	3,827	4,165
Metals and metal products.....	363	155	49,430	24,406
Mines, coal.....	1,019	904	46,768	49,852
Mines (not coal) and quarries.....	35	26	1,554	1,888
Municipal.....	45	48	1,128	1,887
Printing and publishing.....	12	17	2,357	1,965
Public service.....	535	328	28,381	20,219
Textiles.....	9	11	2,335	2,406
Unclassified:				
Beverages.....	2	7	475	505
Hotels and restaurants.....	9	5	703	733
Jobbers and warehouses.....	10	8	1,286	1,283
Laundries.....	11	2	150	179
Tobacco.....		1	216	224
Other.....	24	44	2,927	2,831
Total.....	2,528	1,924	172,451	138,273

A summary of the accidents from 1916 to 1921, classified by industries, appears in Table 19.

The totals show a marked decline from year to year, except for an increase in 1920, due undoubtedly to increased industrial activity.

The metals and metal products industry leads markedly in the earlier years, but thereafter declines rapidly until at the end of the period it is much below coal mines. This change is due to the fact that the hazards of metal production and working are more readily controlled by the safety efforts of recent years than are those of coal mining. The total number of accidents covered by this summary is 1,136,060.

TABLE 19.—NUMBER OF ACCIDENTS IN PENNSYLVANIA, 1916 TO 1921, BY INDUSTRIES.

Industry.	1916	1917	1918	1919	1920	1921	Total.
Chemicals.....	5,918	3,435	3,039	2,274	2,633	2,295	19,594
Clay, glass, and stone.....	7,179	7,012	4,727	4,242	5,736	4,128	33,024
Clothing.....	2,037	1,652	1,107	916	1,211	1,310	8,233
Construction.....	15,146	13,384	9,190	8,209	12,920	10,830	69,679
Food.....	5,101	4,300	2,991	3,219	3,318	3,549	22,478
Leather and rubber.....	2,329	1,939	1,424	1,655	1,930	1,566	10,843
Lumber and its remanufacture.....	4,955	4,433	3,118	3,150	3,593	2,782	22,031
Mercantile.....	4,798	4,129	2,970	2,888	3,854	4,203	22,842
Metals and metal products.....	95,986	75,131	57,134	40,558	49,793	24,561	343,163
Mines, coal.....	52,537	55,128	50,249	44,067	47,787	50,756	300,524
Mines (not coal) and quarries.....	2,420	2,354	1,634	1,446	1,589	1,514	10,957
Municipal.....	983	1,258	968	1,026	1,173	1,935	7,343
Printing and publishing.....	3,514	2,534	1,878	1,897	2,369	1,982	14,174
Public service.....	36,571	37,553	32,625	26,025	28,916	20,547	182,237
Textiles.....	3,888	3,145	2,209	2,084	2,344	2,417	16,087
Unclassified:							
Beverages.....	1,682	1,453	877	689	477	512	5,690
Hotels and restaurants.....	1,125	968	669	533	712	738	4,795
Jobbers and warehouses.....	1,637	1,244	840	1,064	1,296	1,291	7,372
Laundries.....	436	347	233	153	161	181	1,511
Tobacco.....	197	187	136	142	216	225	1,103
Other.....	7,177	6,204	6,826	6,257	2,951	2,875	32,380
Total.....	255,616	227,880	184,844	152,544	174,979	140,197	1,136,060

Table 20 brings out the relation between the several industries and the various causes of accident. In a number of industries "handling tools or objects" as a cause of accident is far in excess of any other item. When, however, fatalities are considered, this cause group is the lowest (98). "Power vehicles" had the heaviest fatality (758 deaths), this being due of course to the inclusion of railways. The large number of deaths (647) caused by "falling objects" is due to accidents in coal mines, where falls of rock are of frequent occurrence.

TABLE 20.—NUMBER OF ACCIDENTS IN PENNSYLVANIA, 1920, BY INDUSTRIES AND CAUSES.

Industry.	Accidents due to specified cause.							Total.
	Ma- chinery.	Hot sub- stances.	Falling objects.	Fall of person.	Hand- ling tools or objects.	Power ve- hicles.	Mis- cella- neous.	
Chemicals and allied products.....	292	210	176	449	919	152	435	2,633
Clay, glass, and stone products.....	606	216	582	632	2,672	369	659	5,736
Clothing manufacture.....	494	30	32	180	305	25	145	1,211
Construction.....	1,184	396	1,733	2,664	4,467	633	1,843	12,920
Food products.....	593	141	183	567	1,278	207	349	3,318
Leather and rubber goods.....	510	56	103	228	731	54	248	1,930
Lumber and its remanufacture.....	1,351	32	222	374	1,200	130	284	3,593
Mercantile.....	485	66	176	986	1,252	336	553	3,854
Metals and metal products.....	10,170	3,877	4,018	4,257	20,858	2,016	4,597	49,793
Mines, coal.....	1,829	2,039	12,697	3,220	15,793	7,704	4,505	47,787
Mines (not coal) and quarries.....	165	68	286	165	617	151	137	1,589
Municipalities.....	60	45	90	367	244	167	200	1,173
Paper and printing industries.....	880	60	124	286	715	80	224	2,369
Public service.....	1,425	1,177	1,617	4,104	11,873	5,924	2,796	28,916
Textiles.....	864	78	95	409	548	42	308	2,344
Miscellaneous.....	606	101	122	688	868	193	373	2,951
Liquor and beverages.....	72	25	20	103	172	28	57	477
Hotels and restaurants.....	58	74	24	207	238	10	101	712
Jobbers and wholesalers.....	148	20	65	240	543	134	146	1,296
Laundries.....	59	10	8	31	27	8	18	161
Tobacco.....	84	.....	5	30	78	6	13	216
Total.....	21,935	8,721	22,378	20,187	65,398	18,369	17,991	174,979
DEGREE OF INJURY.								
Fatal.....	273	345	647	236	98	758	171	2,528
Permanent disability.....	93	21	18	13	49	102	21	317
Temporary disability, compensable.....	13,067	5,035	13,089	11,862	32,099	10,514	7,615	93,281
Temporary disability, noncompensable.....	8,502	3,320	8,624	8,076	33,152	6,995	10,184	78,853

In Table 21 the accidents in the various industries are classified by nature of injury. In 1920 "crushes and bruises" (71,128) were very much in excess of other injuries, the coal mines furnishing the largest number (21,270). "Cuts and lacerations" (44,828) come next, these injuries also being most numerous in coal mining (13,531). The decline from year to year in number of accidents is evident in the table, being distributed quite evenly among the different kinds of injury.

TABLE 21.—NUMBER OF ACCIDENTS IN PENNSYLVANIA, 1920, BY INDUSTRIES AND NATURE OF INJURY.

Industry.	Accidents, classified by nature of injury.										
	Amputations.	Asphyxiations.	Burns and scalds.	Crushes and bruises.	Cuts and lacerations.	Drowning.	Frac-tures.	Her-nia.	Punc-tures	Sprains and disloca-tions.	Un-classified.
Chemicals and allied products	17	12	355	860	515	.....	271	39	148	348	68
Clay, glass, and stone products	41	13	363	1,914	2,013	.....	422	54	253	613	50
Clothing manufacture	8	3	55	329	381	.....	79	16	215	93	32
Construction	71	30	585	4,845	2,904	5	1,630	161	1,017	1,521	151
Food products	39	3	198	1,053	967	.....	331	34	177	473	43
Leather and rubber goods	26	3	105	640	556	.....	128	36	120	250	66
Lumber and its manufacture	119	6	59	1,055	1,460	.....	336	28	220	279	31
Mercantile	32	5	85	1,264	948	.....	523	47	266	619	64
Metals and metal products	638	92	5,654	19,840	12,431	2	3,871	527	1,767	4,639	332
Mines, coal	257	70	1,754	21,270	13,531	5	3,778	338	1,628	4,995	161
Mines (not coal) and quarries	6	.....	52	712	430	4	148	17	31	180	9
Municipalities	7	7	53	383	209	.....	252	12	53	180	17
Paper and printing industries	50	3	101	937	679	.....	190	23	99	271	16
Public service	168	27	1,691	13,434	5,583	6	1,897	223	582	5,125	100
Textiles	25	2	132	813	655	.....	216	23	174	266	38
Miscellaneous	40	6	138	892	799	.....	414	44	175	394	49
Liquor and beverages	6	2	30	144	147	.....	61	4	19	55	9
Hotels and restaurants	5	1	95	167	235	.....	72	9	32	81	15
Jobbers and warehouses	7	1	25	436	277	.....	172	31	85	244	18
Laundries	2	1	38	55	25	.....	12	1	2	24	1
Tobacco	2	.....	1	65	83	.....	13	1	15	32	4
Total	1,566	287	11,569	71,128	44,828	.....	23,14,816	1,668	7,078	20,682	1,334
YEAR.											
1916	.....	.....	17,282	87,071	71,868	.....	15,596	1,254	8,387	21,804	28,599
1917	.....	.....	15,450	82,307	60,565	.....	17,254	1,792	7,140	24,122	16,554
1918	.....	.....	12,934	71,831	51,021	.....	15,309	1,576	4,997	21,404	2,267
1919	.....	.....	10,041	58,988	41,318	.....	12,879	1,371	4,754	18,007	932
1920	1,566	287	11,569	71,128	44,828	.....	23,14,816	1,668	7,078	20,682	1,334
Grand total	.....	.....	66,736	371,325	269,600	.....	75,854	7,661	32,356	106,019	49,716

Table 22 presents the accidents classified by location of injury. As would be expected, the greater number of accidents are to the hands and fingers, there being in 1920, 55,614, the trunk coming next, with 30,235. The 11,597 cases of eye injury seem to be excessive, such injuries being preventable by the use of adequate eye protection such as is now obtainable.

TABLE 22.—NUMBER OF ACCIDENTS IN PENNSYLVANIA, 1920, BY INDUSTRIES AND LOCATION OF INJURY.

Industry.	Accidents, classified by location of injury.								
	Trunk.	Head and face.	Eyes.	Arms.	Hands.	Fingers.	Legs.	Feet.	Toes.
Chemicals and allied products.....	567	250	151	177	314	421	272	379	102
Clay, glass, and stone products.....	845	444	356	377	982	1,205	498	763	266
Clothing manufacture.....	135	65	22	86	189	552	58	87	17
Construction.....	2,599	1,318	719	749	1,395	1,907	1,477	2,252	504
Food products.....	618	202	60	267	560	791	308	388	124
Leather and rubber goods.....	325	117	82	132	288	582	126	201	67
Lumber and its remanufacture.....	489	181	118	176	462	1,297	362	398	110
Mercantile.....	841	206	67	335	591	657	471	514	112
Metals and metal products.....	6,404	3,388	4,772	2,487	5,451	11,512	4,116	7,860	3,803
Mines, coal.....	9,341	5,229	3,147	1,998	4,864	9,060	5,721	6,591	1,836
Mines (not coal) and quarries.....	279	166	104	76	186	270	195	230	83
Municipalities.....	289	121	42	92	150	90	194	160	35
Paper and printing industries.....	347	122	61	163	276	847	175	283	95
Public service.....	5,644	2,971	1,664	1,453	2,898	4,583	3,257	4,594	1,822
Textiles.....	330	128	94	213	387	687	452	582	85
Miscellaneous.....	631	220	88	231	399	678	296	326	82
Liquor and beverages.....	85	22	17	46	97	82	67	76	9
Hotels and restaurants.....	127	43	6	71	150	163	38	67	2
Jobbers and warehouses.....	288	88	22	97	196	191	154	215	45
Laundries.....	22	8	2	12	29	48	12	25	3
Tobacco.....	29	5	3	10	35	82	20	25	7
Total.....	30,235	15,354	11,597	9,248	19,884	35,730	17,985	25,687	9,259
YEAR.									
1916.....	33,440	21,631	20,665	15,129	30,513	62,656	22,954	34,334	14,294
1917.....	35,380	18,985	15,822	13,217	26,130	49,015	22,541	34,496	12,294
1918.....	31,176	16,474	11,727	10,379	20,515	37,265	19,288	27,595	10,425
1919.....	25,812	13,621	9,604	7,955	17,661	31,132	15,976	22,810	7,973
1920.....	30,235	15,354	11,597	9,248	19,884	35,730	17,985	25,687	9,259
Grand total.....	156,043	86,065	69,415	55,928	114,703	215,798	98,744	144,922	54,245

WASHINGTON.

The accident data of the State of Washington shows for 1921 a large number of deaths in the logging industry (127). The operations of lumber manufacture come next, with 48 cases; coal mines with 18 deaths and construction with 17 deaths come next in order.

TABLE 23.—NUMBER OF ACCIDENTS IN WASHINGTON, YEAR ENDING SEPTEMBER 30, 1921, BY INDUSTRIES.

Industry.	Accidents resulting in—			Total accidents.
	Death.	Perma- nent dis- ability.	Tempo- rary dis- ability.	
Chemicals.....	1	3	18	22
Clay.....	1	6	27	34
Construction.....	17	140	560	717
Food.....	3	99	492	594
Logging.....	127	462	1,733	2,322
Lumber.....	48	665	2,158	5,193
Mercantile.....	2	15	39	56
Metals.....	9	142	561	712
Mines, coal.....	18	79	348	445
Mines, not coal.....	3	25	79	107
Municipal.....	11	63	366	440
Paper.....	1	35	92	128
Printing.....	1	23	35	59
Public service.....	8	23	150	181
Shipbuilding.....	10	87	252	349
Textiles.....	1	20	54	75
Unclassified.....	26	82	351	459
Total.....	287	1,969	7,315	9,571

WISCONSIN.

In the accident data reported by Wisconsin only a few of what are considered the more important industries in the State appear separately. Each of these is very elaborately analyzed as to the causes of the accidents. In 1920 the wood industries had the largest number of deaths (38), construction (30 deaths) coming next.

TABLE 24.—NUMBER OF ACCIDENTS IN WISCONSIN, 1920, BY INDUSTRIES.

Industry.	Accidents resulting in—			Total accidents.
	Death.	Permanent disability.	Temporary disability.	
Construction.....	30	174	1,510	1,714
Metal working.....	22	532	4,005	4,559
Mines and quarries.....	3	24	307	334
Paper and paper products.....	10	87	929	1,026
Wood industries.....	38	306	2,543	2,887

Table 25, taken from the Wisconsin report, is a summary, by causes, of six years' experience and consequently is of sufficient volume to be fairly typical. An important feature of the table is the column containing the number of days lost from each cause. These are determined by the application of the standard weighting scale of the International Association of Industrial Accident Boards and Commissions.³

The gross amounts of these time losses are not very significant, since a large loss may simply indicate a group of large size. However, by determining the average loss per case a very definite indication of relative hazard is obtained. Machinery as a whole had 221 days loss per case. Of the different kinds of machinery, transmission apparatus is most hazardous, with 588 days lost per case. Hoisting apparatus, with 343 days lost per case, is next in order. Only two of the other main cause groups had an average time loss per case as great as that for machinery—vehicles (275 days) and hot substances, electricity, etc. (224 days).

³ For scale of time losses for weighting industrial accident disabilities so as to show severity of accidents adopted by the International Association of Industrial Accident Boards and Commissions see U. S. Bureau of Labor Statistics Bul. No. 276: Standardization of industrial accident statistics, p. 18

TABLE 25.—NUMBER OF COMPENSABLE ACCIDENTS AND TIME LOST THEREBY, IN WISCONSIN, 1915 TO 1920, BY CAUSES.

Accident cause.	Accidents resulting in—			Total accidents.	Total days lost.	Average days lost per case.
	Death.	Perma- nent dis- ability	Tempo- rary dis- ability			
Machinery	232	3,991	16,982	21,205	4,691,400	221.24
Engines and motors.....	9	68	660	737	118,068	160.20
Hoisting apparatus.....	108	385	2,728	3,221	1,105,672	343.27
Leather working.....	2	165	585	752	122,342	162.69
Metal working.....	24	1,439	5,111	6,574	1,106,139	168.26
Punch presses.....	2	545	762	1,309	329,358	251.61
Paper.....	7	204	1,271	1,482	225,843	152.39
Textiles.....	1	55	389	445	80,795	181.36
Transmission.....	31	83	428	542	318,566	587.76
Woodworking.....	25	1,164	4,125	5,314	1,053,719	198.29
Saws.....	12	547	1,824	2,383	522,735	219.36
Unclassified.....	25	428	1,685	2,138	560,256	262.05
Hot substances, electricity, etc	151	185	5,382	5,718	1,279,182	223.71
Falling objects.....	152	283	7,405	7,840	1,423,182	181.53
Falls of person.....	160	303	10,869	11,332	1,695,767	149.64
Handling objects and tools.....	80	1,225	27,059	28,364	1,781,827	62.82
Vehicles.....	176	256	5,108	5,540	1,524,010	275.09
Unclassified.....	103	525	8,809	9,437	1,402,689	148.64
Total	1,054	6,768	81,614	89,436	13,798,057	154.28

WYOMING.

In Wyoming coal mining, as in all States where it is a prominent industry, is the chief cause of casualty. The deaths in this industry in 1920 number 28 out of 43 recorded for the State. The oil industry, with 6 deaths, is next in order.

TABLE 26.—NUMBER OF ACCIDENTS IN WYOMING, 1920, BY INDUSTRIES

Industry.	Accidents resulting in—			Total accidents.
	Death.	Perma- nent dis- ability.	Tempo- rary dis- ability.	
Chemicals.....				
Clay.....	2		2	4
Clothing.....				
Construction.....	2	21	51	74
Food.....		8	12	20
Leather.....				
Lumber.....		4	9	13
Mercantile.....	1	4	8	13
Metals.....	1	3	4	8
Mines, coal.....	28	64	375	467
Mines (not coal) and quarries.....	2		4	6
Municipal.....		1		1
Oil.....	6	41	106	153
Printing.....		1	2	3
Public service.....	1	1	13	15
Textile.....				
Unclassified.....		10	32	42
Total	43	158	618	819

SUMMARY.
INDUSTRIES.

In Table 27 will be found a summary of the number of accidents in 1920 in 21 States, classified by industries. The total accidents recorded are 599,781. Omitting Wisconsin, because so small a number of industries are tabulated, and also agriculture and public service, because of the lack of uniformity in the practice of the several States, the percentage distribution of the accidents in the several industries is shown. The following is the order of the more important: Metals and metal products, 25.2 per cent; coal mining, 15.5 per cent; construction, 10.5 per cent; lumber, 7.9 per cent.

This percentage distribution does not afford a satisfactory measure of hazard, since a high percentage may reflect the size of a given industry rather than its hazard. For example, it is known that coal mining, which stands second in percentage of accident cases, is considerably more dangerous than metals and products, which has the largest percentage.

For comparison, the distribution of 1,136,060 Pennsylvania accidents for a period of 6 years (1916 to 1921) is introduced in a parallel column. Inspection immediately detects the greater relative volume of certain industries in Pennsylvania. For example, metals and metal products have 38 instead of 25 per cent as in the summary, and coal mining has 30 as against 16 per cent.

This comparison, however, illustrates further that percentage distribution is an unsafe guide regarding hazard. The 38 per cent of Pennsylvania accidents classified under "Metals and metal products" reflect the size of the group employed in those industries and the liability to numerous minor injuries in some branches. The 30 per cent in coal mining also indicates the size of the industry, but does not emphasize properly the large proportion of serious injury.

It is greatly to be regretted that two of the great industrial States namely, New York and Ohio, have not recently published statistics which could be incorporated in this summary. The other 20 compensation States, which do not record an industrial classification which can be used, form in the aggregate an important element which it is also highly desirable to have represented.

TABLE 27.—NUMBER OF ACCIDENTS IN SPECIFIED STATES, 1920, BY INDUSTRIES.

Industry.	Arkan- sas.	Califor- nia.	Idaho.	Illinois.	Indi- ana.	Kansas.	Ken- tucky.	Mary- land.
Agriculture.....		4,286	120	281	189			
Chemicals.....		2,018		1,324	156		88	72
Clay, glass, and stone.....	3	735		916	1,614	103	490	444
Clothing.....		233		581	135		79	41
Construction.....		8,327	713	3,713	2,731		878	1,249
Food products.....	23	5,274		3,190	2,452	994	1,428	284
Leather and rubber.....		477		506	454		179	210
Lumber and its remanufacture.....	1,160	4,977	1,592	1,982	3,355	47	1,294	102
Lumber: Logging.....								
Lumber: Logging railways.....								
Mercantile.....	5		491	1,965	1,176		810	
Metals and metal products.....	13	7,181		13,881	17,101	978	2,511	1,218
Mines, coal.....				13,249	4,222	873	5,968	
Mines (not coal) and quarries.....	65	4,721	1,210	437	477	235	169	
Municipal.....				231	32			
Oil and gas.....						1,242		
Paper and products.....		419		618	682		34	208
Printing and publishing.....	6	447		705	248		102	204
Public service.....	13	9,132		2,671	4,843	1,944	309	530
Shipbuilding.....		4,288						
Textiles.....	2	137		299	154		211	125
Unclassified.....	130	17,753	960	5,036	2,973	593	1,005	761
Total.....	1,420	70,405	5,086	50,585	42,994	7,009	16,155	6,694

¹ Includes shipbuilding.

TABLE 27.—NUMBER OF ACCIDENTS IN SPECIFIED STATES, 1920, BY INDUSTRIES—
Concluded.

Industry.	Massachusetts.	Minnesota.	Montana. ³	Nevada.	New Jersey.	Oklahoma.	Oregon.	Pennsylvania.
Agriculture.....	196	45	.....	.....	.....	.....	135	.....
Chemicals.....	781	138	.....	.....	1,755	.....	28	2,633
Clay, glass, and stone.....	406	285	68	.....	420	617	64	5,736
Clothing.....	316	38	.....	.....	95	.....	22	1,211
Construction.....	5,032	1,589	2,136	18	5,996	1,620	1,798	12,920
Food products (including beverages).....	2,079	1,611	1,211	33	397	613	772	3,795
Leather and rubber.....	4,664	134	1	.....	598	.....	29	1,930
Lumber and its remanufactures.....	2,174	1,471	1,747	54	.....	1,095	6,677	3,593
Lumber: Logging.....	.....	.....	.....	.....	.....	.....	2,189	.....
Lumber: Logging railways.....	.....	.....	.....	.....	.....	.....	297	.....
Mercantile.....	6,115	714	315	.....	.....	1,348	95	3,854
Metals and metal products.....	13,651	1,638	3,135	160	7,269	1,852	1,069	49,793
Mines, coal.....	.....	.....	1,969	.....	.....	1,112	24	47,787
Mines (not coal) and quarries.....	184	2,193	18,710	769	84	3,934	237	1,589
Municipal.....	.....	206	109	58	.....	.....	22	1,173
Oil and gas.....	.....	.....	.....	.....	.....	7,821	.....	.....
Paper and products.....	2,041	246	.....	.....	86	.....	.....	.....
Printing and publishing.....	718	133	131	.....	65	113	418	2,369
Public service.....	8,271	469	820	41	.....	746	151	28,916
Shipbuilding.....	.....	.....	.....	.....	2,817	.....	1,062	.....
Textiles.....	11,246	115	71	.....	277	.....	120	2,344
Unclassified.....	7,614	1,713	955	43	8,982	1,843	666	5,336
Total.....	65,488	12,738	31,314	1,176	28,841	22,714	13,389	174,979

Industry.	South Dakota. ³	Tennessee. ³	Washington.	Wisconsin.	Wyoming.	Total.	Per cent of total accidents. ⁴	Per cent of total accidents in Pennsylvania, 1916-1921.
Agriculture.....	102	.....	.....	.....	.....	5,354	.....	.....
Chemicals.....	.....	375	22	.....	.....	9,390	1.88	2.07
Clay, glass, and stone.....	.....	504	34	.....	4	12,443	2.49	3.46
Clothing.....	.....	67	.....	.....	.....	2,818	.56	.83
Construction.....	501	1,366	717	1,714	74	54,337	10.54	7.05
Food products.....	630	1,431	594	.....	20	26,881	5.38	2.27
Leather and rubber.....	.....	295	.....	.....	.....	9,477	1.90	1.11
Lumber and its remanufacture.....	47	3,005	5,193	2,887	13	42,465	7.93	2.31
Lumber: Logging.....	.....	.....	2,322	.....	.....	.....	.....	.....
Lumber: Logging railways.....	.....	.....	.....	.....	.....	.....	.....	.....
Mercantile.....	59	1,229	50	.....	13	17,245	3.45	2.23
Metals and metal products.....	45	2,835	712	4,559	8	129,659	25.20	38.19
Mines, coal.....	.....	1,256	445	.....	407	77,372	15.50	29.94
Mines (not coal) and quarries.....	688	211	107	334	6	36,350	7.23	1.13
Municipal.....	.....	.....	440	.....	.....	2,272	.46	.65
Oil and gas.....	.....	.....	.....	.....	153	.....	.....	.....
Paper and products.....	.....	306	128	1,026	.....	5,794	.95	.....
Printing and publishing.....	40	183	59	.....	3	5,944	1.19	1.46
Public service.....	137	442	181	.....	15	59,631	.....	.....
Shipbuilding.....	.....	.....	349	.....	.....	8,516	.....	.....
Textiles.....	.....	641	75	.....	.....	15,754	3.16	1.64
Unclassified.....	475	2,943	459	7,921	42	68,803	12.19	5.64
Total.....	2,724	17,189	9,571	18,441	819	599,731	100.00	100.00

³ 1915-1920.

³ 1921.

⁴ Not including Wisconsin and agriculture and public service.

CAUSE OF INJURY.

Eighteen States recorded their accidents according to a cause classification. This information for 1920 is embodied in Table 28. The total number of accidents so classified is 714,023. That this total is larger than that in Table 27 is due to the fact that Ohio is included, this State having published a classification by causes of 182,970 accidents.

As in all such classifications, "handling tools or objects" has in nearly every State the largest number of accidents, with "machinery" very generally coming next. It should be noted that in this table hoisting apparatus, which is sometimes not included with machines, is so included. Failure to recognize that hoisting apparatus is a form of machine has contributed to an inadequate estimate of the importance of machines in accident causation.

The per cent of the total accidents attributed to the various causes is as follows: Machinery, 21.25 per cent; hot substances, electricity, etc., 5.54 per cent; falling objects, 10.48 per cent; falls of person, 10.41 per cent; handling, 32.62 per cent; vehicles, 6.71 per cent; unclassified, 12.94 per cent.

TABLE 28.—NUMBER OF ACCIDENTS IN THE SPECIFIED STATES, 1920, BY CAUSE OF INJURY.

State.	Accidents due to specified cause.							Total.
	Machin- ery.	Hot sub- stances.	Falling objects.	Falls of person.	Hand- ling tools or objects.	Vehi- cles.	Unclassi- fied.	
California.....	8,410	4,283	5,688	9,465	24,445	6,867	11,247	70,405
Idaho ¹	495	116	1,471	752	1,313	222	588	4,957
Illinois ²	7,240	2,928	8,204	5,799	12,276	4,683	9,455	50,585
Indiana.....	1,101	1,856	6,187	5,384	9,304	1,772	8,792	34,396
Kentucky ³	1,232	842	3,820	625	5,733	.....	3,903	16,155
Maryland ¹	1,036	395	1,150	1,087	1,284	588	1,154	6,694
Massachusetts.....	15,307	3,029	2,412	9,176	23,931	4,149	7,484	65,488
Minnesota ¹	2,475	603	1,088	1,769	4,282	1,351	1,170	12,738
New Jersey ²	2,986	1,014	6,446	2,424	7,652	2,905	4,609	28,036
North Dakota.....	173	74	114	148	498	147	177	1,331
Ohio.....	79,043	12,442	6,404	8,417	58,551	4,391	13,722	182,970
Oregon.....	2,979	431	1,335	1,888	4,755	769	1,232	13,389
Pennsylvania.....	21,935	8,721	22,378	20,187	65,398	18,369	17,991	174,979
Tennessee.....	675	1,302	2,877	3,009	2,666	465	6,195	17,189
Vermont.....	971	200	2,057	669	2,613	26	1,544	8,090
Washington ³	1,615	278	1,865	1,588	2,824	558	843	9,571
Wisconsin.....	3,986	986	1,063	1,826	5,245	577	2,565	16,248
Wyoming.....	91	53	273	95	156	74	70	812
Total.....	151,750	39,553	74,832	74,308	232,926	47,913	92,741	714,023

¹ Compensation claims allowed.

² Compensable cases only.

³ Data for year ending June 30, 1921.

NATURE OF INJURY.

Twelve States have published accidents classified by the nature of injury. The facts are assembled in Table 29. The accidents in the two groups, "Bruises" and "Cuts, lacerations, and punctures," are more numerous than all others combined. That nearly half the cases of burns are in Pennsylvania is due to the predominance in that State of the basic processes of the iron and steel industry. The number of cases of asphyxiations is related to the same condition.

TABLE 29.—NUMBER OF ACCIDENTS IN SPECIFIED STATES, 1920, BY NATURE OF INJURY.

State.	Accidents, classified by nature of injury.								Total.
	Ampu- ta- tions.	As- phyxi- ations.	Burns, etc.	Bruises.	Cuts, lacer- ations, and punc- tures.	Frac- tures.	Sprains and dislo- cations.	Unclass- ified.	
California.....	1, 285		3, 145	17, 987	20, 232	7, 641	12, 549	7, 566	70, 405
Idaho ¹	24		139	1, 280	2, 144	657	624	261	5, 129
Illinois ²	2, 156		3, 043	12, 344	16, 287	5, 877	7, 204	3, 674	50, 585
Indiana.....	622		1, 891	8, 765	6, 351	2, 790	3, 980	9, 997	34, 396
Kentucky ¹	256		477	2, 153	3, 275	1, 191	1, 194	1, 044	9, 590
Maryland ¹	393		595	1, 309	1, 075	876	655	1, 851	6, 694
Massachusetts.....	1, 538		3, 147	16, 907	21, 819	4, 357	11, 305	6, 415	65, 488
Minnesota.....	313	26	625	3, 773	3, 446	2, 288	1, 822	445	12, 738
Montana.....			122	1, 560	1, 586	465	429	752	4, 914
Pennsylvania.....	1, 566	287	11, 569	71, 128	51, 906	14, 816	20, 682	3, 025	174, 979
Tennessee.....	185		1, 233	4, 076	5, 837	903	1, 440	3, 515	17, 189
Wyoming.....			80	412	(⁴)	184	84	52	812
Total.....	8, 338	313	26, 006	141, 694	133, 958	42, 045	61, 968	38, 597	452, 919

¹ Claims allowed.² Compensable cases.³ Including cuts, lacerations, and punctures.⁴ Included under "Bruises."

LOCATION OF INJURY.

In Table 30 is shown information from 11 States regarding the bodily part which suffered injury. Neither nature nor location of injury is of great significance in accident prevention. The only item of serious importance is the number of eye injuries. This serves to emphasize still further what has been already said, that these accidents would almost disappear if the standard rules and specifications regarding protection of head and eyes should be vigorously applied.

TABLE 30.—NUMBER OF ACCIDENTS IN SPECIFIED STATES, 1920, BY LOCATION OF INJURY.

State.	Accidents, classified by location of injury.						Total.
	Head, face, and neck.	Eyes.	Trunk.	Upper ex- tremities.	Lower ex- tremities.	Unclassi- fied.	
California.....	4, 023	5, 204	9, 937	29, 469	19, 741	2, 031	70, 405
Idaho ¹	423	393	725	1, 970	1, 545	80	5, 136
Illinois ²	3, 067	2, 439	7, 401	22, 752	14, 926		50, 585
Indiana ³	2, 390	2, 813	4, 103	13, 498	9, 783	1, 809	34, 396
Kentucky ¹	2, 173		2, 949	7, 113	4, 352		16, 587
Maryland ¹	394	240	557	2, 603	2, 070	830	6, 694
Massachusetts.....	3, 645	3, 446	8, 570	31, 667	17, 091	1, 069	65, 488
Minnesota.....	527	434	2, 487	5, 681	3, 551	58	12, 738
Oklahoma.....	2, 008	3, 084	2, 747	9, 071	5, 202	602	22, 714
Pennsylvania.....	15, 354	11, 597	30, 235	64, 862	52, 931		174, 979
Wyoming ¹	102	13	102	254	307	34	812
Total.....	34, 106	29, 663	69, 813	188, 940	131, 499	6, 513	460, 534

¹ Compensable cases.² Compensation claims allowed.³ 1921.

STEAM RAILWAYS.

The Interstate Commerce Commission publishes quarterly an accident bulletin containing very detailed information regarding accidents in connection with the operation of American steam railroads; that for the fourth quarter contains a summary for the year. The data for accidents on steam railways herein set forth have been taken from these reports.

Table 31 presents the number killed and injured in railway operation from 1888 to 1921. No other American industrial group has been recorded with equal completeness for so long a time. The most significant column is that of employees killed. While the number is irregular, it shows a distinct tendency to decline, which would be conspicuous if it were possible to relate these occurrences to the greatly expanding volume of employment during these years. The very great increase in injuries until about 1916 in part is due to the expansion of railway operations and in part reflects a more complete recording than was possible in earlier years.

The number of "other persons" killed shown in the table bears startling testimony to the steady increase of hazard to the general public from the grade crossing. A very large part of these casualties are due to the growth of automobile traffic. With thousands of motor cars constantly crossing the tracks of the steam railways casualties could not but increase unless more drastic measures are taken than has yet been thought possible.

TABLE 31.—NUMBER OF PASSENGERS, EMPLOYEES, AND OTHER PERSONS KILLED OR INJURED IN REPORTABLE STEAM RAILWAY ACCIDENTS OF ALL KINDS IN THE UNITED STATES, 1888 TO 1921.¹

Year ending—	Passengers.		Employees.		Other persons.		Total.	
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
June 30, 1888.....	315	2,138	2,070	20,148	2,897	3,602	5,282	25,888
June 30, 1889.....	310	2,146	1,972	20,028	3,541	4,135	6,823	26,309
June 30, 1890.....	286	2,425	2,451	22,396	3,598	4,206	6,335	29,027
June 30, 1891.....	293	2,972	2,660	26,140	4,076	4,769	7,029	33,881
June 30, 1892.....	276	3,227	2,554	28,267	4,217	5,158	7,147	36,652
June 30, 1893.....	299	3,229	2,727	31,729	4,320	5,435	7,346	40,393
June 30, 1894.....	324	3,034	1,823	23,422	4,300	5,433	6,447	31,889
June 30, 1895.....	170	2,375	1,811	25,696	4,155	5,677	6,136	33,748
June 30, 1896.....	181	2,873	1,861	29,969	4,406	5,845	6,448	38,687
June 30, 1897.....	222	2,795	1,693	27,667	4,522	6,269	6,437	36,731
June 30, 1898.....	221	2,945	1,958	31,761	4,680	6,176	6,859	40,882
June 30, 1899.....	239	3,442	2,210	34,923	4,674	6,255	7,123	44,620
June 30, 1900.....	249	4,128	2,550	39,643	5,066	6,549	7,865	50,320
June 30, 1901.....	282	4,988	2,675	41,142	5,498	7,209	8,455	53,339
June 30, 1902.....	345	6,683	2,969	50,524	5,274	7,455	8,588	64,662
June 30, 1903.....	355	8,231	3,006	60,481	5,879	7,841	9,840	76,553
June 30, 1904.....	441	9,111	3,632	67,067	5,973	7,977	10,046	81,155
June 30, 1905.....	537	10,457	3,361	66,833	5,805	8,718	9,703	86,008
June 30, 1906.....	359	10,764	3,929	76,701	6,330	10,241	10,618	97,706
June 30, 1907.....	610	13,041	4,534	87,644	6,695	10,331	11,839	111,016
June 30, 1908.....	381	11,556	3,405	82,487	6,402	10,187	10,188	104,230
June 30, 1909.....	253	10,311	2,610	75,006	5,859	10,309	8,722	95,626
June 30, 1910.....	324	12,451	3,382	95,671	5,976	11,385	9,682	119,507
June 30, 1911.....	299	12,042	3,602	126,039	6,495	12,078	10,396	150,159
June 30, 1912.....	283	14,938	3,635	142,442	6,667	12,158	10,585	169,538
June 30, 1913.....	350	15,130	3,715	171,417	6,899	13,761	10,964	200,308
June 30, 1914.....	232	13,887	3,259	165,212	6,811	13,563	10,302	192,662
June 30, 1915.....	199	10,914	2,152	138,092	6,270	13,034	8,621	162,040
June 30, 1916.....	239	7,488	2,687	160,663	6,438	12,224	9,364	180,375
Dec. 31, 1916.....	246	7,152	2,941	176,923	6,814	12,647	10,001	196,722
Dec. 31, 1917.....	301	7,582	3,199	174,247	6,587	12,976	10,087	194,805
Dec. 31, 1918.....	471	7,316	3,419	156,013	5,396	11,246	9,286	174,575
Dec. 31, 1919.....	273	7,456	2,138	131,018	4,567	10,579	6,978	149,053
Dec. 31, 1920.....	229	7,991	2,578	149,414	4,151	11,304	6,953	168,309
Dec. 31, 1921.....	205	5,584	1,446	104,530	4,345	10,571	5,996	120,685

¹ Figures for years 1911 to 1915 include industrial and other nontrain accidents to employees only; and for years 1908 to 1910 do not cover switching and terminal roads; otherwise, the statement covers all reportable accidents.

In Table 32 are shown for the years 1917 to 1921 the casualties to the various classes of persons injured, the most significant figures being those for trainmen.

TABLE 32.—ACCIDENTS ON STEAM RAILWAYS OF ALL CLASSES IN THE UNITED STATES, 1917 TO 1921, BY CLASSES OF PERSONS INJURED.

Class.	1917		1918		1919		1920		1921	
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
Train and train service accidents.										
TRESPASSERS.										
Employees.....	149	207	74	98	133	193	89	189	72	123
Other persons.....	4,094	3,622	3,181	2,707	2,420	2,465	2,077	2,179	2,409	2,943
Total trespassers.....	4,243	3,829	3,255	2,805	2,553	2,658	2,166	2,368	2,481	3,071
NONTRESPASSERS.										
Employees on duty:										
Trainmen.....	1,492	47,887	1,606	42,944	984	32,844	1,265	42,840	658	25,968
Other employees.....	1,124	4,349	1,153	4,017	709	3,436	842	4,080	438	2,556
Employees not on duty.....	165	544	169	595	66	321	91	314	41	223
Passengers.....	301	7,582	471	7,316	273	7,456	229	7,591	205	5,584
Persons carried under contract.....	42	792	48	766	28	691	35	865	21	560
Other nontrespassers.....	2,200	5,987	1,995	5,701	1,882	5,195	1,867	5,723	1,743	5,362
Total nontrespassers.....	5,324	67,141	5,442	61,339	3,942	49,943	4,329	61,418	3,106	40,253
Grand total.....	9,567	70,970	8,697	64,144	6,495	52,601	6,495	63,786	5,587	43,324
Nontrain accidents.										
Employees not concerned with operation of trains.....	418	121,467	491	108,457	379	94,417	380	102,180	309	75,783
Other persons.....	102	2,398	98	1,974	104	2,035	83	2,343	100	1,578
Total.....	520	123,835	589	110,431	483	96,452	463	104,523	409	77,361

TRAINMEN.

Table 33 gives the average number of employees classed as trainmen on Class I railroads⁴ in the years 1917 to 1921, the number of accidents which occurred to employees in each class, and accident frequency rates per 1,000 employees.

It will be noticed that the whole group of trainmen have a declining fatality rate. The rate drops from 4.48 in 1917 to 1.79 in 1921, or 60 per cent. The decline in the frequency rate for injuries is also notable but not so significant. In three of the five years yard brakemen have the highest fatality rate (8.28, 6.67, and 3.79); in the other years road freight brakemen are higher (7.63 and 5.00). The highest rates found elsewhere are 9.9 for erectors of structural steel in 1920 and 6.9 for logging operations in Oregon in the same year. It is evident that the brakemen have been subject to a hazard nearly as serious as that of the most dangerous occupations. In frequency of nonfatal injury the yard brakemen exceed all other trainmen in each of the five years. The lowest casualty rates are for passenger conductors.

⁴Class I roads are those roads whose annual operating revenues are above \$1,000,000.

TABLE 33.—AVERAGE NUMBER OF RAILWAY EMPLOYEES CLASSED AS TRAINMEN ON CLASS I ROADS IN THE UNITED STATES, NUMBER OF ACCIDENTS, AND ACCIDENT FREQUENCY RATES PER 1,000 EMPLOYED, 1917 TO 1921 BY OCCUPATIONS

Occupation.	Average number of trainmen.									
	1917	1918	1919	1920	1921					
Yardmasters	3,719	4,036	3,931	4,371	3,660					
Yardmaster's assistants	2,507	3,217	3,274	3,697	2,784					
Yard engineers and motormen	18,933	21,310	19,625	22,924	17,895					
Yard firemen and helpers	19,156	21,979	20,031	23,191	18,334					
Yard conductors (or foremen)	18,703	20,823	19,325	21,940	17,675					
Yard brakemen (switchmen or helpers)	48,451	53,790	49,303	54,383	44,642					
Yard switch tenders	4,848	5,119	5,985	6,366	5,778					
Other yard employees	3,984	4,277	4,750	5,014	4,199					
Road freight engineers and motormen	34,155	34,990	30,907	33,895	28,330					
Road freight firemen and helpers	36,828	38,102	32,938	36,169	30,332					
Road freight conductors	27,152	27,679	25,181	27,690	22,600					
Road freight brakemen and flagmen	67,818	69,048	61,989	68,140	56,625					
Road passenger engineers and motormen	13,297	12,709	12,442	13,100	12,926					
Road passenger firemen and helpers	13,105	12,419	12,112	12,691	12,770					
Road passenger conductors	10,655	10,444	10,382	10,911	10,548					
Road passenger baggagemen	5,524	5,371	5,442	5,744	5,753					
Road passenger brakemen and flagmen	14,854	14,423	14,904	15,976	15,317					
Total	343,689	359,736	332,521	366,102	310,168					
	Number of accidents.									
	Killed.	In-jured.	Killed.	In-jured.	Killed.	In-jured.	Killed.	In-jured.	Killed.	In-jured.
Yardmasters	3	71	10	78	70	5	120	5	91	
Yardmaster's assistants	5	64	4	50	42	4	68	1	24	
Yard engineers and motormen	16	1,032	11	908	15	680	9	1,023	11	546
Yard firemen and helpers	23	1,905	27	1,708	14	1,171	18	1,691	7	854
Yard conductors (or foremen)	78	1,815	73	1,440	50	1,249	67	1,607	39	1,094
Yard brakemen (switchmen or helpers)	401	12,004	397	10,472	235	8,296	363	11,666	169	6,711
Yard switch tenders	16	193	17	180	14	133	14	187	6	148
Other yard employees	15	76	6	52	6	53	15	56	9	33
Road freight engineers and motormen	72	2,578	84	2,547	66	1,888	63	2,130	32	1,404
Road freight firemen and helpers	122	6,232	132	5,706	70	3,945	84	5,085	36	2,791
Road freight conductors	88	3,099	104	2,832	63	2,253	62	2,693	48	1,921
Road freight brakemen and flagmen	478	13,094	527	11,938	310	8,829	396	11,439	186	7,012
Road passenger engineers and motormen	56	738	59	777	50	660	69	804	37	602
Road passenger firemen and helpers	49	1,444	50	1,253	51	1,176	52	1,535	36	997
Road passenger conductors	5	327	11	304	6	263	6	274	9	209
Road passenger baggagemen	8	368	5	283	4	292	4	344	2	269
Road passenger brakemen and flagmen	18	699	25	674	17	579	16	688	10	570
Total	1,453	45,739	1,542	41,202	977	31,579	1,247	41,410	643	25,276

TABLE 33.—AVERAGE NUMBER OF RAILWAY EMPLOYEES CLASSED AS TRAINMEN ON CLASS I ROADS IN THE UNITED STATES, NUMBER OF ACCIDENTS, AND ACCIDENT FREQUENCY RATES PER 1,000 EMPLOYED, 1917 TO 1921, BY OCCUPATIONS—Concluded.

Occupation.	Accident frequency rates (per 1,000 employees).									
	1917.		1918		1919.		1920.		1921.	
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
Yardmasters	0.81	19.09	2.48	19.33	.....	17.81	1.14	27.45	1.37	24.86
Yardmasters' assistants	1.99	25.53	1.24	15.54	1.83	12.83	1.08	18.39	.36	8.62
Yard engineers and motormen	1.85	54.51	.52	42.61	.76	34.65	.39	44.63	.61	30.51
Yard firemen and helpers	1.18	97.61	1.23	77.71	.70	58.46	.78	72.92	.38	46.58
Yard conductors (or foremen)	4.17	97.04	3.51	69.15	2.59	64.63	3.05	73.25	2.21	61.90
Yard brakemen (switchmen or helpers)	8.28	247.76	7.38	194.68	4.77	168.27	6.67	214.52	3.79	150.33
Yard switch tenders	3.30	39.81	3.32	35.16	2.34	22.22	2.20	29.37	1.04	25.62
Other yard employees	3.77	19.08	1.40	12.16	1.26	11.16	2.99	11.17	2.14	7.86
Road freight engineers and motormen	2.11	75.48	2.40	72.79	2.14	61.09	1.86	62.84	1.13	49.56
Road freight firemen and helpers	3.31	169.22	3.46	149.76	2.13	119.77	2.32	140.59	1.87	92.02
Road freight conductors	3.24	114.14	3.76	102.32	2.50	89.47	2.25	97.61	2.12	85.00
Road freight brakemen and flagmen	7.05	193.08	7.63	172.89	5.00	142.43	5.81	167.88	3.29	123.83
Road passenger engineers and motormen	4.21	55.50	4.64	61.14	4.02	53.05	5.27	61.38	2.86	46.57
Road passenger firemen and helpers	3.74	110.19	4.03	100.89	4.21	97.09	4.10	120.95	2.82	78.07
Road passenger conductors .....	.47	30.69	1.05	29.11	.58	25.33	.55	25.11	.85	19.81
Road passenger baggagemen	1.45	66.62	.93	52.69	.74	53.65	.70	59.89	.35	46.76
Road passenger brakemen and flagmen	1.21	47.06	1.73	46.73	1.14	38.85	1.00	43.06	.65	37.21
Total	4.23	119.76	4.29	114.53	3.75	124.53	1.76	69.04	1.79	70.18

NONTRAIN EMPLOYEES.

Table 34 contains the number of accidents to nontrain employees of Class I railroads for the years 1917 to 1921, classified by causes. The table also gives frequency rates for each cause, based on the following exposure for industrial employees: 1917, 3,727,490,000 hours; 1918, 3,925,030,000 hours; 1919, 3,521,480,000 hours; 1920, 3,763,970,000 hours; 1921, 2,808,498,000 hours. The fatality rate for this group of employees, who are mostly shopmen, does not change materially, but there is something of a drop in the non-fatal-accident rates.

Throughout the years covered by this table the most serious cause of fatality is "falls of person." Next to this in nearly every year comes "handling tools or objects," and with a rather surprisingly high frequency.

TABLE 34.—NUMBER OF NONTRAIN ACCIDENTS ON CLASS I RAILROADS IN THE UNITED STATES AND FREQUENCY RATES (PER 1,000,000 HOURS' EXPOSURE) 1917 to 1921.

NUMBER OF ACCIDENTS.

Accident cause.	1917			1918			1919			1920			1921		
	Killed.	Injured.	Total.	Killed.	Injured.	Total.	Killed.	Injured.	Total.	Killed.	Injured.	Total.	Killed.	Injured.	Total.
Working machinery, engines, motors, etc.....	15	4,741	4,756	38	4,835	4,873	17	3,885	3,902	22	4,087	4,109	13	2,919	2,932
Transmission apparatus.....	5	530	535	7	585	592	6	460	466	3	489	492	7	343	350
Handling tools and objects.....	38	44,855	44,893	42	37,196	37,238	52	33,340	33,392	39	35,489	35,528	25	25,858	25,883
Flying particles.....	1	7,423	7,424	4	6,897	6,901	.....	5,536	5,536	1	5,744	5,745	2	4,227	4,229
Explosives and inflammable, hot, or corrosive substances.....	21	2,949	2,970	21	2,857	2,878	16	2,356	2,372	13	2,648	2,661	13	1,875	1,888
Electric currents.....	24	185	209	25	245	270	22	223	245	9	221	230	16	124	140
Collapse, fall, etc., of objects.....	42	14,087	14,129	56	13,132	13,188	42	10,536	10,578	44	11,822	11,866	27	8,341	8,368
Falls of persons.....	98	13,892	13,990	111	12,474	12,585	89	9,871	9,960	76	10,906	10,982	59	7,725	7,784
Miscellaneous industrial causes.....	119	27,570	27,689	131	25,642	25,773	97	23,867	23,964	131	26,260	26,381	92	20,037	20,129
Total industrial accidents.....	363	116,232	116,595	435	103,863	104,298	341	90,074	90,415	338	97,656	97,994	254	71,449	71,703
Other nontrain accidents.....	13	978	991	18	1,037	1,055	18	768	786	23	637	660	.....	.....	.....
Total nontrain accidents.....	376	117,210	117,586	453	104,900	105,353	359	90,842	91,201	361	98,293	98,654	254	71,449	71,703

ACCIDENT FREQUENCY RATES (PER 1,000,000 HOURS' EXPOSURE).

Working machinery, engines, motors, etc.....	0.004	1.27	1.28	0.010	1.23	1.24	0.005	1.10	1.11	0.006	1.09	1.09	0.004	1.04	1.04
Transmission apparatus.....	.001	.14	.14	.002	.15	.15	.002	.13	.13	.0007	.13	.13	.002	.12	.12
Handling tools and objects.....	.010	12.03	12.04	.011	9.48	9.49	.015	9.47	9.48	.010	9.43	9.44	.008	9.20	9.21
Flying particles.....	.0003	1.99	1.99	.001	1.76	1.76	.....	1.57	1.57	.0002	1.53	1.53	.0007	1.50	1.50
Explosives and inflammable, hot, or corrosive substances.....	.006	.79	.80	.005	.73	.73	.005	.67	.67	.003	.70	.71	.004	.66	.67
Electric currents.....	.006	.05	.06	.006	.06	.07	.006	.06	.07	.002	.06	.06	.005	.04	.04
Collapse, fall, etc., of objects.....	.011	3.78	3.79	.014	3.35	3.36	.012	2.99	3.00	.011	3.14	3.15	.009	2.96	2.97
Falls of persons.....	.026	3.73	3.75	.028	3.18	3.21	.025	2.80	2.83	.020	2.90	2.92	.021	2.75	2.77
Miscellaneous industrial causes.....	.032	7.40	7.43	.033	6.53	6.57	.028	6.78	6.81	.035	7.09	7.18	.032	7.13	7.16
Total, industrial accidents.....	.097	31.18	31.28	.111	26.46	26.57	.097	25.58	25.68	.0897	26.12	26.21	.090	25.44	25.53

In Table 35 the number of fatal and nonfatal accidents among the nontrain employees are shown by occupation groups, such as shopmen, stationmen, trackmen, etc., and in Table 36 are presented accident frequency rates for such employees. Among these groups the shopmen show constantly the highest frequency, but the bridge and building men have a much higher severity.

TABLE 35.—NUMBER OF NONTRAIN ACCIDENTS ON CLASS I RAILROADS IN THE UNITED STATES, 1917 TO 1921, BY OCCUPATIONS AND CAUSES.

Accident cause.	1917		1918		1919		1920		1921	
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
Shopmen.										
Working machinery, engines, motors, etc.	7	4,148	26	4,303	12	3,394	17	3,541	8	2,522
Transmission apparatus.	4	406	4	476	5	373	3	402	6	266
Handling tools and objects.	10	18,335	11	17,022	13	13,557	13	14,440	4	10,103
Flying particles.	1	5,928	2	5,576	.....	4,319	1	4,514	1	3,171
Explosives and inflammable, hot, or corrosive substances.	10	2,521	12	2,460	11	2,035	6	2,367	8	1,651
Electric currents.	7	103	10	168	10	158	4	139	9	79
Collapse, fall, etc., of objects.	11	10,339	23	9,613	15	7,755	21	8,909	13	6,400
Falls of persons.	27	7,089	26	6,658	27	5,283	22	6,075	15	4,601
Miscellaneous industrial causes.	41	18,458	64	17,497	28	15,323	43	16,880	17	12,874
Total industrial accidents.	118	67,327	178	63,773	121	52,197	130	57,267	81	41,667
Other nontrain accidents.	1	225	4	262	.....	192	3	198	.....	.....
Total nontrain accidents.	119	67,552	182	64,035	121	52,389	133	57,465	.....	.....
Station men.										
Working machinery, engines, motors, etc.	1	32	.....	35	.....	19	1	31	.....	22
Transmission apparatus. ....	.....	8	.....	9	.....	11	.....	11	.....	9
Handling tools and objects.	11	10,431	8	7,779	10	7,584	8	7,907	2	4,520
Flying particles. ....	.....	56	.....	72	.....	44	.....	50	.....	34
Explosives and inflammable, hot, or corrosive substances.	1	66	2	55	.....	47	1	54	3	37
Electric currents. ....	.....	3	.....	13	.....	1	1	9	.....	4
Collapse, fall, etc., of objects.	1	1,538	1	1,321	3	865	.....	1,015	.....	548
Falls of persons.	1	1,561	9	1,298	3	1,030	2	992	5	669
Miscellaneous industrial causes.	7	1,918	4	1,544	2	1,587	6	1,576	4	1,087
Total industrial accidents.	22	15,613	24	12,126	18	11,188	19	11,645	14	6,930
Other nontrain accidents.	1	39	.....	63	.....	29	.....	25	.....	.....
Total nontrain accidents.	23	15,652	24	12,189	18	11,217	20	11,670	.....	.....
Trackmen.										
Working machinery, engines, motors, etc. ....	.....	271	7	258	2	255	1	262	.....	206
Transmission apparatus. ....	.....	37	1	40	1	35	.....	35	.....	24
Handling tools and objects.	7	12,226	14	9,497	10	9,635	9	10,419	12	9,022
Flying particles. ....	.....	1,094	2	932	.....	886	.....	922	1	863
Explosives and inflammable, hot, or corrosive substances.	4	118	2	117	3	87	3	75	.....	77
Electric currents.	5	18	2	9	2	16	2	26	1	17
Collapse, fall, etc., of objects.	8	939	8	949	6	830	7	916	5	676
Falls of persons.	26	2,447	27	2,139	17	1,661	28	1,934	21	1,194
Miscellaneous industrial causes.	31	3,805	39	3,455	30	3,774	51	4,423	34	3,625
Total industrial accidents.	81	20,955	102	17,396	71	17,179	101	19,012	74	15,704
Other nontrain accidents.	6	144	6	214	7	215	9	133	.....	.....
Total nontrain accidents.	87	21,099	108	17,610	78	17,394	110	19,145	.....	.....

TABLE 35.—NUMBER OF NONTRAIN ACCIDENTS ON CLASS I RAILROADS IN THE UNITED STATES, 1917 TO 1921, BY OCCUPATIONS AND CAUSES—Continue!

Accident cause.	1917		1918		1919		1920		1921	
	Killed.	In-jured.	Killed.	In-jured.	Killed.	In-jured.	Killed.	In-jured.	Killed.	In-jured.
Bridge and building men.										
Working machinery, engines, motors, etc.	1	100	.....	69	1	75	.....	92	.....	78
Transmission apparatus. ....	.....	23	1	30	.....	22	.....	19	1	24
Handling tools and objects.	5	2,167	6	1,629	7	1,432	5	1,535	5	1,327
Flying particles. ....	.....	161	.....	138	.....	116	.....	127	.....	96
Explosives and inflammable, hot, or corrosive substances.	2	54	3	42	.....	55	.....	43	.....	27
Electric currents.	2	8	.....	6	3	9	.....	6	2	4
Collapse, fall, etc., of objects.	16	522	13	530	10	443	10	425	7	361
Falls of persons.	26	1,027	21	885	17	719	15	863	12	585
Miscellaneous industrial causes.	8	982	6	820	17	909	7	1,020	15	854
Total industrial accidents.	60	5,044	51	4,149	55	3,780	37	4,130	42	3,356
Other nontrain accidents. ....	.....	24	2	43	.....	21	3	28	.....	.....
Total nontrain accidents.	60	5,068	53	4,192	55	3,801	40	4,158	.....	.....
Other employees.										
Working machinery, engines, motors, etc.	6	190	5	170	2	142	3	161	5	91
Transmission apparatus.	1	56	1	30	.....	19	.....	22	.....	20
Handling tools and objects.	5	1,696	3	1,269	12	1,132	4	1,188	2	896
Flying particles. ....	.....	184	.....	179	.....	171	.....	131	.....	63
Explosives and inflammable, hot, or corrosive substances.	4	190	2	183	2	132	3	109	2	83
Electric currents.	10	53	12	49	7	39	2	41	4	20
Collapse, fall, etc., of objects.	6	749	11	719	8	643	6	557	2	358
Falls of persons.	18	1,768	28	1,494	25	1,178	9	1,042	6	676
Miscellaneous industrial causes.	32	2,407	18	2,326	20	2,274	24	2,351	22	1,597
Total industrial accidents.	82	7,293	80	6,419	76	5,730	51	5,602	43	3,792
Other nontrain accidents.	5	546	6	455	11	311	7	253	.....	.....
Total nontrain accidents.	87	7,839	86	6,874	87	6,041	58	5,855	.....	.....
Total employees.										
Working machinery, engines, motors, etc.	15	4,741	38	4,835	17	3,885	22	4,087	13	2,919
Transmission apparatus.	5	530	7	585	6	460	3	489	7	343
Handling tools and objects.	38	44,855	42	37,196	52	33,340	39	35,489	25	25,858
Flying particles.	1	7,423	4	6,897	.....	5,536	1	5,744	2	4,227
Explosives and inflammable, hot, or corrosive substances.	21	2,949	21	2,857	16	2,356	13	2,618	13	1,875
Electric currents.	24	185	25	245	22	223	9	221	16	124
Collapse, fall, etc., of objects.	42	14,087	56	13,132	42	10,536	44	11,822	27	8,341
Falls of persons.	98	13,892	111	12,474	89	9,871	76	10,906	59	7,725
Miscellaneous industrial causes.	119	27,570	131	25,642	97	23,867	131	26,250	92	20,037
Total industrial accidents.	363	116,232	435	103,863	341	90,474	338	97,656	254	71,449
Other nontrain accidents.	13	978	18	1,037	18	768	23	637	.....	.....
Total nontrain accidents.	376	117,210	453	104,900	359	90,842	361	98,293	.....	.....

TABLE 36.—NUMBER OF NONTRAIN ACCIDENTS, NUMBER OF HOURS' EXPOSURE, AND ACCIDENT FREQUENCY RATES (PER 1,000,000 HOURS' EXPOSURE) FOR INDUSTRIAL EMPLOYEES ON CLASS I RAILROADS IN THE UNITED STATES, 1917 TO 1921, BY OCCUPATIONS.

Occupation	1917	1918	1919	1920	1921
Number of accidents.					
Shopmen.....	67,445	63,951	52,318	57,397	41,748
Station men.....	15,635	12,150	11,206	11,664	6,944
Trackmen.....	21,036	17,498	17,250	19,113	15,778
Bridge and building men.....	5,104	4,200	3,835	4,167	3,398
Other employees.....	7,375	6,499	5,806	5,653	3,835
Total.....	116,595	104,298	90,415	97,994	71,703
Hours of exposure (thousands)					
Shopmen.....	1,400,734	1,582,114	1,456,460	1,584,884	1,150,383
Station men.....	689,174	690,048	620,370	644,202	511,918
Trackmen.....	1,019,263	1,031,366	888,206	955,570	678,478
Bridge and building men.....	203,314	202,575	165,072	168,550	117,742
Other employees.....	415,005	418,927	391,372	410,764	349,977
Total.....	3,727,490	3,925,030	3,521,480	3,763,970	2,808,498
Accident frequency rates (per 1,000,000 hours' exposure).					
Shopmen.....	48.15	40.42	35.92	36.22	36.29
Station men.....	22.69	17.61	18.06	18.11	13.56
Trackmen.....	20.64	16.97	19.42	20.00	23.25
Bridge and building men.....	25.10	20.73	23.23	24.72	28.87
Other employees.....	17.77	15.51	14.83	13.76	10.96
Total.....	31.28	26.57	25.68	26.03	25.53

Table 37 shows the frequency rates per 1,000,000 hours' exposure for nontrain employes for the five-year period, 1917 to 1921.

TABLE 37.—ACCIDENT FREQUENCY RATES (PER 1,000,000 HOURS' EXPOSURE) FOR NONTRAIN EMPLOYEES ON CLASS I RAILROADS IN THE UNITED STATES, 1917 TO 1921.

Occupation.	Fatalities.	All accidents.
Shopmen.....	0.09	39.54
Station men.....	.03	18.30
Trackmen.....	.10	20.00
Bridge men.....	.30	24.29

GRADE-CROSSING ACCIDENTS.

Table 38 is introduced for the purpose of adding to the force of what has been said already regarding the hazards of grade crossings. The maximum number of deaths at such places is found in 1917. The number of injuries was slightly more in 1920 than in 1917. The increase of such accidents is known to be due to increased use of automobiles, together with increased traffic on the railways. While a perfect solution of the problem can scarcely come without doing away altogether with grade crossings great improvement may be expected with the installation of better systems of warning and the greater use of protective gates. For a long time, however, the main reliance for reduction of accidents must be on more careful driving. To this end the railways have instituted the "cross crossings carefully" cam-

paign, and another year ought to indicate whether this form of effort brings results.

Table 38 also indicates that accidents due to trespass have declined quite materially in recent years. Whether this is due to special efforts on the part of the railways or is the result of a lessened number of trespassers it is impossible to determine.

TABLE 38.—NUMBER OF PERSONS AND NUMBER OF TRESPASSERS KILLED OR INJURED IN RAILWAY ACCIDENTS AT HIGHWAY GRADE CROSSINGS IN THE UNITED STATES, 1890 TO 1921.

Year ending—	Number of persons—		Number of trespassers—	
	Killed.	Injured.	Killed.	Injured.
June 30, 1890.....	402	675	98	151
June 30, 1891.....	564	863	167	162
June 30, 1892.....	568	942	137	176
June 30, 1893.....	596	1,064	163	179
June 30, 1894.....	571	817	119	136
June 30, 1895.....	508	961	133	176
June 30, 1896.....	615	1,058	171	248
June 30, 1897.....	575	1,033	116	197
June 30, 1898.....	657	1,123	151	202
June 30, 1899.....	674	1,087	170	168
June 30, 1900.....	730	1,297	171	204
June 30, 1901.....	831	1,354	209	242
June 30, 1902.....	827	1,335	265	272
June 30, 1903.....	898	1,481	271	247
June 30, 1904.....	808	1,463	197	224
June 30, 1905.....	838	1,574	215	256
June 30, 1906.....	929	1,892	250	226
June 30, 1907.....	934	1,817	237	274
June 30, 1908.....	837	1,762	216	323
June 30, 1909.....	735	1,833	112	211
June 30, 1910.....	839	1,939	129	153
June 30, 1911.....	992	2,434	148	124
June 30, 1912.....	1,032	2,506	136	138
June 30, 1913.....	1,125	3,080	145	172
June 30, 1914.....	1,147	2,935	122	119
June 30, 1915.....	1,086	2,981	83	72
June 30, 1916.....	1,306	3,267	86	83
Dec. 31, 1916.....	1,652	3,859	121	101
Dec. 31, 1917.....	1,969	4,764	131	128
Dec. 31, 1918.....	1,852	4,683	137	140
Dec. 31, 1919.....	1,784	4,616	107	216
Dec. 31, 1920.....	1,791	5,077	100	273
Dec. 31, 1921.....	1,705	4,868	106	166

IRON AND STEEL INDUSTRY.

The Bureau of Labor Statistics was called upon in 1910 to make a special study of the iron and steel industry, and a section of the investigation then conducted was devoted to the subject of accidents. Since that time such information has been continuously assembled and the results have been published from time to time. For detailed discussion of the various phases of the accident problem as found in the iron and steel industry recourse must be had to the published bulletins,⁵ particularly Bulletin No. 298.

Table 39 is arranged to show the number of accidents and accident frequency and severity rates for the industry and the several departments for two 5-year periods, 1910 to 1914 and 1915 to 1919, and the years 1920 and 1921. The 1921 figures for the several departments have not hitherto been published.

⁵ Conditions of employment in the iron and steel industry of the United States, Vol. IV, Accidents and accident prevention (Doc. No. 110, 62d Cong., 1st sess.); U. S. Bureau of Labor Statistics Bul. No. 216: Accidents and accident prevention in machine building; Bull. No. 234: The safety movement in the iron and steel industry; Bul. No. 256: Accidents and accident prevention in machine building; Bul. No. 298: Causes and prevention of accidents in the iron and steel industry.

TABLE 39.—ACCIDENTS AND ACCIDENT RATES IN THE IRON AND STEEL INDUSTRY IN THE UNITED STATES, 1910 TO 1921, BY DEPARTMENTS.

Period or year.	Equivalent number of full-year workers.	Number of cases.				Accident frequency rates (per 1,000,000 hours' exposure).				Accident severity rates (per 1,000 hours' exposure).			
		Death.	Perma-nent disabili-ty.	Tempo-rary disabili-ty.	Total.	Death.	Perma-nent disabili-ty.	Tempo-rary disabili-ty.	Total.	Death.	Perma-nent disabili-ty.	Tempo-rary disabili-ty.	Total.
The industry.													
1910-1914...	1,310,911	1,524	5,080	226,305	232,954	0.4	1.3	57.5	59.2	2.3	1.1	0.7	4.1
1915-1919...	1,545,706	1,731	4,469	186,532	192,732	.4	1.0	40.2	41.6	2.2	.8	.6	3.6
1920.....	442,685	327	1,084	49,482	50,893	.2	.8	37.3	38.3	1.5	.8	.4	2.7
1921.....	237,094	156	527	21,279	21,962	.2	.7	29.9	30.8	1.3	.7	.5	2.5
Blast furnaces.													
1910-1914...	126,582	324	366	22,578	23,268	0.9	1.0	60.4	62.3	5.2	1.0	0.8	7.0
1915-1919...	136,166	317	312	15,287	15,916	.8	.8	37.4	39.0	4.7	.9	.5	6.1
1920.....	35,470	47	58	3,214	3,319	.4	.5	30.2	31.1	2.7	.9	.4	4.0
1921.....	15,486	23	24	1,160	1,207	.5	.5	25.0	26.0	3.0	.5	.4	3.9
Bessemer department.													
1910-1914...	28,101	57	146	7,367	7,570	0.7	1.7	87.4	89.8	4.0	1.1	1.3	6.4
1915-1919...	25,645	62	112	4,262	4,436	.8	1.5	55.4	57.7	4.8	1.1	1.0	6.9
1920.....	6,907	5	9	750	764	.2	.4	36.2	36.8	1.4	.3	.6	2.3
1921.....	3,440	4	6	252	262	.4	.6	24.4	25.4	2.3	.4	.4	3.1
Open hearths.													
1910-1914...	71,293	143	333	15,809	16,285	0.7	1.5	72.8	75.0	4.0	1.6	1.0	6.6
1915-1919...	86,175	191	317	12,563	13,071	.7	1.2	48.6	50.5	4.4	1.2	.9	6.5
1920.....	28,823	43	70	3,164	3,277	.5	.8	37.0	38.3	3.0	.8	.5	4.3
1921.....	12,783	9	21	1,082	1,112	.2	.6	28.2	29.0	1.4	.4	.5	2.3
Foundries.													
1910-1914...	95,917	84	449	17,765	18,298	0.3	1.6	61.7	63.6	1.8	1.1	0.7	3.6
1915-1919...	92,746	84	277	16,604	16,985	.3	1.0	59.7	61.0	1.8	.9	.7	3.4
1920.....	35,300	13	97	6,688	6,798	.1	.9	63.2	64.2	.7	.8	.8	2.3
1921.....	15,388	9	34	2,756	2,799	.2	.7	59.7	60.6	1.2	.7	.8	2.7
Bar mills.													
1915-1919...	24,081	20	77	4,745	4,842	0.3	1.1	65.6	67.0	1.7	0.7	0.7	3.1
1920.....	3,880	1	5	525	527	.1	.4	44.8	45.3	.5	.2	.5	1.2
1921.....	1,912	.....	5	228	233	.....	.9	39.8	40.7	.....	1.0	.6	1.6
Heavy rolling mills.													
1910-1914...	67,663	74	261	9,007	9,342	0.4	1.3	44.4	46.1	2.1	0.9	0.6	3.6
1915-1919...	75,166	91	275	6,950	7,316	.4	1.2	30.8	32.4	2.4	1.0	.5	3.9
1920.....	20,787	12	34	1,638	1,684	.2	.5	26.3	27.0	1.2	.4	.4	2.0
1921.....	9,000	3	15	485	503	.1	.5	16.5	17.1	.6	.3	.3	1.2

TABLE 39.—ACCIDENTS AND ACCIDENT RATES IN THE IRON AND STEEL INDUSTRY IN THE UNITED STATES, 1910 TO 1921, BY DEPARTMENTS—Continued.

Period of year.	Equivalent number of full-year workers.	Number of cases.				Accident frequency rates (per 1,000,000 hours' exposure).				Accident severity rates (per 1,000 hours' exposure).			
		Death.	Perma- nent dis- ability.	Temp- orary dis- ability.	Total.	Death.	Perma- nent dis- ability.	Temp- orary dis- ability.	Total.	Death.	Perma- nent dis- ability.	Temp- orary dis- ability.	Total.
Plate mills.													
1910-1914 . . .	27,711	19	105	3,129	3,253	0.3	1.6	48.0	49.9	1.8	1.4	0.7	3.9
1915-1919 . . .	35,073	25	89	4,016	4,130	.2	.8	38.2	39.2	1.4	.6	.5	2.5
1920	11,928	9	23	1,147	1,179	.3	.6	32.1	33.0	1.5	.6	.4	2.5
1921	4,580	3	7	318	328	.2	.5	23.1	23.8	1.3	.3	.4	2.0
Rod mills													
1915-1919 . . .	15,218	14	70	1,721	1,805	0.3	1.5	37.7	39.5	1.8	1.3	0.5	3.6
1920	3,729	1	9	344	354	.1	.8	30.7	31.6	.5	.5	.4	1.5
1921	2,099	.....	6	126	132	.....	1.0	20.0	21.0	.....	.7	.3	1.0
Sheet mills													
1910-1914 . . .	128,423	88	308	19,262	19,658	0.2	0.9	50.0	51.1	1.4	0.6	0.6	2.6
1915-1919 . . .	104,335	37	172	10,034	10,243	.1	.5	32.1	32.7	.7	.4	.4	1.5
1920	24,279	14	59	2,979	3,052	.2	.8	40.1	41.0	1.2	.7	.8	2.3
1921	15,845	5	38	1,702	1,745	.1	.8	35.8	36.7	.6	.5	.5	1.6
Tube mills.													
1910-1914 . . .	73,338	36	249	8,623	8,908	0.2	1.1	39.2	40.5	1.0	0.7	0.5	2.2
1915-1919 . . .	75,108	38	178	4,825	5,041	.2	.8	21.4	22.4	1.0	.5	.3	1.8
1920	22,666	13	71	2,166	2,250	.2	1.0	31.9	33.1	1.1	.5	.5	2.1
1921	14,622	4	35	840	879	.1	.8	19.1	20.0	.5	.5	.4	1.4
Miscellaneous rolling mills.													
1910-1914 . . .	104,829	82	360	21,501	21,943	0.3	1.2	71.8	73.3	1.7	1.1	0.9	3.7
1915-1919 . . .	102,696	253	218	12,644	12,915	.2	.7	41.0	41.9	1.0	.5	.6	2.1
1920	29,898	19	81	3,713	3,813	.2	.9	41.4	42.5	1.3	.8	.6	2.7
1921	12,068	4	36	1,479	1,519	.1	1.0	40.9	42.0	.7	.9	.7	2.3
Fabricating shops.													
1910-1914 . . .	108,538	98	425	25,506	26,029	0.3	1.3	78.3	79.9	1.7	0.9	0.8	3.4
1915-1919 . . .	80,985	59	163	13,195	13,417	.2	.7	54.3	55.2	1.5	.5	.6	2.6
1920	17,216	14	68	2,721	2,803	.2	1.3	52.7	54.2	1.6	1.1	.6	3.3
1921	12,908	5	45	1,971	2,021	.1	1.2	50.9	52.2	.8	.7	.6	2.1
Forge shops.													
1910-1914 . . .	6,249	8	19	1,080	1,107	0.4	1.0	57.6	59.0	2.6	0.6	0.7	3.9
1915-1919 . . .	12,667	9	45	2,189	2,243	.2	1.2	57.6	59.0	1.4	1.1	.9	3.4
1920	2,197	.....	5	380	385	.....	.8	58.6	59.4	.....	.8	.7	1.5
1921	902	1	3	107	111	.4	1.1	39.5	41.0	2.2	1.0	.7	3.9

TABLE 39.—ACCIDENTS AND ACCIDENT RATES IN THE IRON AND STEEL INDUSTRY IN THE UNITED STATES, 1910 TO 1921, BY DEPARTMENTS—Continued.

Period or year.	Equiv- alent num- ber of full-year workers.	Number of cases.				Accident frequency rates (per 1,000,000 hours' ex- posure).				Accident severity rates (per 1,000 hours' ex- posure).			
		Death.	Per- man- ent dis- abil- ity.	Tem- porary disabil- ity.	Total.	Death.	Per- man- ent dis- abil- ity.	Tem- porary disabil- ity.	Total.	Death.	Per- man- ent dis- abil- ity.	Tem- porary disabil- ity.	Total.
Wire drawing.													
1910-1914 . . .	59,481	21	383	11,504	11,908	0.1	2.1	63.5	65.7	0.7	1.9	0.6	3.2
1915-1919 . . .	52,666	12	321	6,912	7,245	.1	2.0	43.7	45.8	.5	1.6	.5	2.6
1920	13,243	2	63	1,252	1,317	.1	1.6	31.5	33.2	.3	1.7	.5	2.5
1921	9,186	4	36	527	567	.1	1.3	19.1	20.6	.9	1.4	.4	2.7
Electrical department.													
1910-1914 . . .	14,921	33	48	1,957	2,038	0.8	1.1	45.2	47.1	4.6	1.2	0.5	6.3
1915-1919 . . .	16,023	46	40	1,851	1,937	1.0	.8	38.5	40.3	5.7	1.0	.5	7.2
1920	4,473	5	3	403	411	.4	.2	30.0	30.6	2.2	.1	.4	2.7
1921	3,025	2	3	188	193	.2	.3	20.7	21.2	1.3	.6	.3	2.2
Mechanical department.													
1910-1914 . . .	97,161	104	392	17,794	18,292	0.4	1.3	61.0	62.7	2.1	1.1	0.8	4.0
1915-1919 . . .	154,846	154	492	18,556	19,202	.3	1.1	39.9	41.3	2.0	1.0	.5	3.5
1920	34,648	26	68	3,767	3,861	.3	.7	36.2	37.2	1.5	.6	.5	2.6
1921	25,086	21	41	1,703	1,775	.3	.5	22.7	23.6	1.7	.5	.4	2.5
Power houses.													
1912-1914 . . .	8,083	6	21	544	571	0.2	0.9	22.4	23.5	1.5	0.8	0.3	2.6
1915-1919 . . .	13,219	27	21	739	787	.7	.5	18.6	19.8	4.1	.6	.3	5.0
1920	4,591	4	1	172	177	.3	.1	12.5	12.9	1.7	(¹)	.2	1.9
1921	2,344	2	.....	77	79	.3	.....	10.9	11.2	1.7	.....	.2	1.9
Yards.													
1910-1914 . . .	55,932	112	243	8,112	8,467	0.7	1.5	48.6	50.8	4.0	1.4	0.6	6.0
1915-1919 . . .	53,890	106	258	5,685	6,049	.7	1.6	35.2	37.5	3.9	1.6	.6	6.1
1920	12,067	10	33	922	965	.3	.9	25.4	26.6	1.7	1.3	.4	3.4
1921	5,840	6	22	422	450	.3	1.3	24.1	25.7	2.1	1.9	.5	4.4
Coke ovens.²													
1912-1914 . . .	13,282	27	39	1,651	1,717	0.7	1.0	41.4	43.1	4.1	1.5	0.6	6.2
1915-1919 . . .	28,901	66	44	2,095	2,205	.8	.5	24.1	25.4	4.6	.5	.4	5.5
1920	8,620	6	11	518	535	.2	.4	10.0	10.6	1.4	.7	.3	2.4
1921	5,768	2	4	182	188	.1	.2	10.5	10.8	.7	.3	.2	1.1
Armor plates.													
1911-1914 . . .	3,000	4	12	362	378	0.4	1.3	40.2	41.9	2.7	0.5	0.7	3.9
1916-1919 . . .	4,761	9	5	705	719	.6	.4	49.9	50.4	3.8	.3	.8	4.9
1920	1,517	1	.....	140	141	.2	.....	30.8	31.0	1.3	.....	.5	1.8
1921	1,134	1	2	105	108	.3	.6	30.9	31.7	1.8	.6	.6	3.0

¹ Less than 0.05.

² These figures are for coke plants operated in connection with steel plants. For a more complete statement see publications of Bureau of Mines.

TABLE 39.—ACCIDENTS AND ACCIDENT RATES IN THE IRON AND STEEL INDUSTRY IN THE UNITED STATES, 1910 TO 1921, BY DEPARTMENTS—Concluded.

Period or year.	Equivalent number of full-year workers.	Number of cases.				Accident frequency rates (per 1,000,000 hours' exposure).				Accident severity rates (per 1,000 hours' exposure).			
		Death.	Perma- nent dis- abili- ty.	Tempo- rary disabi- lity.	Total.	Death.	Perma- nent dis- abili- ty.	Tempo- rary disabi- lity.	Total.	Death.	Perma- nent dis- abili- ty.	Tempo- rary disabi- lity.	Total.
Axle works.													
1912-1914...	1,326	2	4	438	444	0.5	1.0	110.1	111.6	3.0	2.1	1.6	6.7
1915-1919...	2,467	.....	4	338	342	.....	.5	45.7	46.2	.....	1.2	.....	1.9
1920.....	743	.....	.....	100	100	.....	.....	44.8	44.8	.....	.....	.....	.7
1921.....	242	1	.....	12	13	1.3	.....	16.5	17.9	8.3	.....	.....	8.7
Car wheels.													
1912-1914...	2,367	3	15	609	627	0.4	2.1	85.8	88.3	2.5	0.9	1.3	4.7
1915-1919...	5,904	7	18	1,313	1,333	.4	1.0	74.1	75.5	2.4	.5	1.0	3.9
1920.....	1,215	.....	4	170	174	.....	1.0	46.7	47.7	.....	.9	.....	1.5
1921.....	552	1	2	92	97	.6	1.2	56.7	58.6	3.6	.5	.7	4.9
Docks and ore yards.													
1911-1914...	1,293	3	11	139	153	0.8	2.8	35.8	39.4	4.6	2.8	0.8	8.2
1915-1919...	1,353	6	12	175	193	1.4	2.9	42.2	46.5	8.7	4.1	.5	13.3
1920.....	379	1	2	12	15	.9	1.8	10.6	13.3	5.3	2.9	.1	8.3
1921.....	235	.....	.....	11	11	.....	.....	15.6	15.6	.....	.....	.....	.5
Erection of structural steel.													
1912-1914...	2,157	26	94	738	788	4.0	3.7	114.0	121.7	24.1	5.5	1.8	31.4
1915-1919...	4,979	45	35	1,522	1,602	3.0	2.3	101.9	107.2	18.1	2.6	1.6	22.3
1920.....	637	6	12	204	222	3.3	6.6	111.8	121.7	19.7	3.7	2.5	25.9
1921.....	573	5	4	168	177	2.9	2.3	97.8	103.0	17.5	1.1	1.7	20.2
Wire fence.													
1915-1919....	7,311	1	47	684	732	0.1	2.1	31.2	33.4	0.3	1.6	0.3	2.2
1920.....	1,097	.....	6	48	54	.....	1.8	14.6	16.4	.....	2.9	.....	3.1
1921.....	1,095	.....	3	79	82	.....	.9	24.1	30.0	.....	.8	.....	1.2
Nails.													
1915-1919...	9,818	2	56	782	840	0.1	1.9	26.5	28.5	0.4	1.3	0.3	2.0
1920.....	2,364	.....	8	164	172	.....	1.1	23.1	24.2	.....	.8	.....	.9
1921.....	1,718	1	6	191	198	.2	1.2	17.7	19.0	1.2	.6	.3	2.1
Hot mills.													
1920.....	6,660	2	12	624	638	0.1	0.6	31.2	31.9	0.6	0.5	0.4	1.5
1921.....	3,728	3	3	424	430	.3	.3	37.9	38.5	1.6	.2	.5	2.3
Cold rolling.													
1920.....	1,205	1	6	230	237	0.3	1.7	63.9	65.9	1.7	0.5	0.7	2.9
1921.....	506	1	1	75	77	.7	.7	49.4	50.7	4.0	1.2	.7	5.9
Unclassified.													
1915-1919...	293,329	237	706	30,612	31,555	0.3	0.8	34.8	35.9	1.6	1.3	0.5	3.4
1920.....	104,741	72	261	11,208	11,541	.2	.8	35.7	36.7	1.4	.9	.5	2.8
1921.....	53,403	36	134	4,468	4,638	.2	.8	27.9	28.9	1.3	.8	.5	2.6

The figures in Table 39 for the industry as a whole show as between the two 5-year periods a definite decline in accident rates. The two years which follow have lower rates than those for the average of the preceding five years and there was a slight decline from 1920 to 1921.

The accident rates for blast furnaces are among the highest found in the industry, but as an offset some of the most definite reductions which can anywhere be found are recorded for this department.

While the figures for total accident frequency in the Bessemer department make a very satisfactory series, the severity rates for the second 5-year period are higher than for the first five years and 1921 is higher than 1920.

Open hearths are shown to have a marked decline in accident frequency, while the severity rates, though in less degree, have still definitely declined. The accident rates for foundries are somewhat disappointing as regards the progress of accident prevention. As compared with the basic metallurgical processes the foundries have a lower accident severity with a higher accident frequency.

Heavy rolling mills show a steady and marked decline in accident frequency, but in severity the second 5-year period was slightly higher than the first. In 1920 and 1921, however, there was quite a drop. From the first 5-year period to 1921 severity declined 67 per cent. Plate mills exhibit one of the most uniform declines in both frequency and severity of accidents which is on record. Frequency had a decline of 54 per cent and severity of 50 per cent during the period covered.

The accident rates for sheet mills were strikingly low at the beginning of the period and from that low point decline irregularly but definitely. Tube mills share with sheet mills the lowest accident rates, both frequency and severity, found in any of the departments of the iron and steel industry. A notable feature of their experience is the very striking decline in accident frequency which the table shows. This is related quite closely with the large use, in mills of this type, of a foreman's bonus for accident reduction.

The production of the structural elements of bridges and steel frame buildings is shown by the accident rates for fabricating shops to be a matter of considerable hazard. These accident rates have declined in considerable measure and quite regularly. In wire drawing a very notable decline is to be observed in accident frequency. Accident severity does not, however, follow the same course.

The electrical department taken as a whole does not display as favorable a change in accident rates as the experience of particular plants shows to be possible. However, the rates for 1920 and 1921 were much lower than the two 5-year periods, and the maintenance of this condition will set a new record for another five years. The mechanical departments of steel plants are of rather greater hazard than ordinary machine shops. This is due in part to the fact that a good deal of their work is unusually heavy and difficult, including much urgent heavy repair work.

The yard operations of all industrial plants present a difficult problem for the safety man. This is particularly true of the iron and steel industry on account of the nature and volume of materials which must be moved. That these difficulties have not all been overcome is evident on inspection of the accident rates for this department. The accident severity rates for the two 5-year periods

are practically identical. The years 1920 and 1921 had lower rates but those for 1921 were the higher.

Accident rates for the erection of structural steel, while covering a much smaller exposure than could be desired, are, however, highly suggestive. Thus far no industrial group has been discovered which has as high rates as those here recorded. The only approach to it is the record of logging and saw-mill operations. The accident severity rate in Oregon in 1920 for logging (see Table 17) is 21.56 per 1,000 hours' exposure and for logging railways 20.24. In the erection of structural steel the five years from 1910 to 1914 had an accident severity rate of 31.4, and the five years from 1915 to 1919 a rate of 22.3, while the 1920 rate was 25.9 and that for 1921 was 20.2. It is evident that improvement has been fairly regular.

Table 40 gives a more precise idea of the trend of events in specified departments, the accident rates being computed for 5-year intervals from that ending in 1911 to that ending in 1921. The decline in accident frequency from the first period to the last in the several departments was as follows: The industry, 43 per cent; blast furnaces, 52 per cent; Bessemer, 64 per cent; open hearths, 47 per cent; heavy rolling mills, 51 per cent; plate mills, 46 per cent; and sheet mills, 24 per cent. In accident severity the decline was as follows: The industry, 32 per cent; blast furnaces, 46 per cent; Bessemer, 29 per cent; open hearths, 23 per cent; heavy rolling mills, 25 per cent; plate mills, 50 per cent; and sheet mills, 45 per cent.

Foundries is the only department to show an increase for both accident frequency (5 per cent) and severity (20 per cent). Two departments, plate mills and sheet mills, show a greater decline in accident severity than in frequency; the others have a greater decline in frequency.

It should be noted that these percentages of decline do not give a complete idea regarding the relations of these departments. The rates as found in the tables must be compared, since they represent the actual conditions in any given interval.

TABLE 40.—TREND OF ACCIDENT RATES IN SPECIFIED DEPARTMENTS OF THE IRON AND STEEL INDUSTRY, BY 5-YEAR PERIODS.

5-year period.	Industry.	Blast furnaces.	Bessemer.	Open hearth.	Foundries.	Heavy rolling mills.	Plate mills.	Sheet mills.
Accident frequency rates (per 1,000,000 hours' exposure).								
1907 to 1911.....	69.2	76.1	101.5	84.2	60.1	61.0	69.4	44.1
1908 to 1912.....	65.1	67.7	79.5	79.5	61.5	57.0	60.8	47.9
1909 to 1913.....	62.1	62.4	92.3	78.6	65.1	51.7	55.9	49.1
1910 to 1914.....	59.2	59.2	89.8	76.1	63.6	46.0	49.9	51.0
1911 to 1915.....	53.3	50.3	65.0	67.6	59.3	39.4	44.7	48.1
1912 to 1916.....	51.3	47.8	76.1	64.8	57.8	37.3	41.5	47.4
1913 to 1917.....	48.2	44.1	68.3	58.4	60.4	32.1	36.6	41.3
1914 to 1918.....	43.6	40.5	60.7	53.5	57.0	31.1	39.8	35.8
1915 to 1919.....	41.2	38.6	57.7	50.5	55.6	32.0	39.2	32.7
1916 to 1920.....	41.1	38.0	53.1	50.2	61.0	31.4	38.4	33.7
1917 to 1921.....	39.5	36.3	47.0	44.8	63.1	29.9	37.6	33.4
Accident severity rates (per 1,000 hours' exposure).								
1907 to 1911.....	5.0	10.6	7.6	7.5	2.7	4.4	5.1	3.1
1908 to 1912.....	4.3	8.8	7.4	6.6	3.1	4.2	4.1	2.8
1909 to 1913.....	4.4	8.3	6.7	6.8	3.5	4.0	3.8	3.0
1910 to 1914.....	4.1	7.0	6.4	6.6	3.6	3.8	3.8	2.6
1911 to 1915.....	3.6	6.2	5.3	5.8	3.3	3.4	3.1	2.2
1912 to 1916.....	3.7	5.8	6.1	5.5	3.1	3.5	2.8	2.3
1913 to 1917.....	3.7	5.6	7.1	5.1	3.3	3.6	2.6	2.1
1914 to 1918.....	3.5	5.4	7.3	5.8	3.2	3.4	2.6	1.8
1915 to 1919.....	3.6	5.8	7.0	6.2	3.1	3.9	2.5	1.6
1916 to 1920.....	3.5	5.7	6.3	6.3	3.2	3.5	2.6	1.8
1917 to 1921.....	3.4	5.7	5.4	5.8	3.2	3.3	2.5	1.7

A showing similar to that of Table 40 is presented in Table 41. In this table the facts are analyzed by mills producing certain products, and the rates are computed for the years ending in alternate months.

The results shown are very remarkable, and there is no indication that the reductions in accident frequency rates may not go still further. The sheet mills show a practically continuous decline, while the other mills show an increase during the war period, with continued and accelerated decline afterwards. It is possible, indeed probable, that the low figures of 1921 are due in part to the depressed state of the industry, and it should occasion no surprise if the revival seen in 1922 should be accompanied by rising accident rates.

TABLE 41.—ACCIDENT FREQUENCY RATES (PER 1,000,000 HOURS' EXPOSURE) FOR MILLS MAKING SPECIFIED PRODUCTS, DECEMBER, 1913, TO DECEMBER, 1921, BY YEARS ENDING WITH EACH ALTERNATE MONTH.

Year ending with—	Fabricated products.	Sheets.	Wire products.	Tubes.	Miscellaneous steel products.		Total.
					Group A.	Group B.	
December, 1913.....	100.3	61.6	59.3	27.2	70.9	41.3	60.3
February, 1914.....	92.2	58.9	54.7	24.0	69.3	38.5	57.3
April, 1914.....	88.2	56.6	53.1	21.2	67.3	35.5	54.7
June, 1914.....	75.5	53.7	51.0	19.1	62.8	33.3	51.6
August, 1914.....	66.7	49.4	48.9	16.0	57.8	31.0	47.9
October, 1914.....	61.6	47.2	46.8	13.9	53.5	28.4	45.0
December, 1914.....	59.0	47.2	46.2	12.5	50.7	27.6	43.5
February, 1915.....	55.1	46.6	45.4	11.1	45.4	27.7	41.0
April, 1915.....	53.3	44.7	43.2	9.3	42.3	26.4	39.1
June, 1915.....	51.2	41.8	44.3	8.7	42.7	23.3	38.0
August, 1915.....	50.9	39.0	46.2	9.6	45.0	20.1	38.1
October, 1915.....	51.8	38.0	51.4	10.5	48.5	21.0	40.3
December, 1915.....	53.5	37.3	52.4	10.8	51.9	23.0	41.5
February, 1916.....	53.3	37.0	52.8	11.3	57.5	25.4	43.3
April, 1916.....	52.7	37.1	52.9	12.1	61.2	25.4	44.2
June, 1916.....	54.5	36.5	52.2	12.2	62.7	27.0	44.7
August, 1916.....	54.7	36.1	51.1	12.3	66.0	28.5	45.4
October, 1916.....	53.4	35.2	48.9	12.2	67.6	29.0	45.0
December, 1916.....	52.1	34.0	48.2	12.4	67.6	28.2	44.4
February, 1917.....	53.1	33.6	46.4	12.1	66.5	26.6	43.4
April, 1917.....	54.3	32.3	45.0	11.6	64.6	25.8	42.2
June, 1917.....	53.3	32.3	42.6	11.5	62.2	24.5	40.5
August, 1917.....	52.7	34.9	39.5	10.7	57.9	22.5	38.3
October, 1917.....	52.5	34.2	36.0	10.4	54.2	21.0	36.2
December, 1917.....	51.3	33.9	32.5	10.2	51.3	20.5	34.5
February, 1918.....	48.7	33.1	30.7	10.0	48.6	20.0	32.9
April, 1918.....	46.9	32.7	27.6	10.0	46.7	21.6	31.9
June, 1918.....	45.7	31.3	24.6	9.9	45.2	24.3	31.1
August, 1918.....	42.6	27.5	22.1	9.9	44.0	28.3	30.2
October, 1918.....	40.0	26.5	19.9	9.6	42.6	29.9	29.2
December, 1918.....	38.2	25.9	18.8	9.1	42.0	31.4	28.8
February, 1919.....	37.3	26.1	17.4	9.2	41.8	31.5	28.6
April, 1919.....	35.8	25.6	16.2	9.1	41.5	30.7	28.1
June, 1919.....	33.6	24.4	15.4	8.7	40.7	28.4	27.1
August, 1919.....	32.3	24.7	14.2	8.5	39.2	25.5	26.2
October, 1919.....	33.3	25.1	13.1	8.7	38.7	24.5	25.9
December, 1919.....	32.8	25.8	12.5	9.1	39.7	23.0	26.1
February, 1920.....	33.1	25.4	12.5	9.1	39.3	22.5	25.9
April, 1920.....	33.7	24.9	12.5	9.0	38.7	21.1	25.3
June, 1920.....	35.3	25.0	12.2	9.2	38.0	21.2	25.0
August, 1920.....	35.6	24.1	12.4	9.2	37.0	20.3	24.4
October, 1920.....	35.1	23.6	12.6	9.1	37.0	19.5	24.0
December, 1920.....	35.3	22.7	12.0	8.9	35.3	18.6	22.9
February, 1921.....	35.8	22.0	10.8	8.3	33.3	17.4	21.7
April, 1921.....	34.5	21.5	9.9	7.6	30.4	16.8	20.2
June, 1921.....	32.4	20.2	9.3	7.3	27.6	15.5	18.7
August, 1921.....	32.0	20.3	8.4	7.0	24.2	14.2	17.2
October, 1921.....	30.8	19.1	7.9	6.5	19.8	13.3	15.2
December, 1921.....	28.4	17.5	7.5	6.1	15.8	12.1	13.2

Table 42 contrasts the rates of the two 5-year periods for the main cause groups. The constancy with which the second 5-year period shows lower rates is very striking, and affords evidence that the forces making for lower rates have exercised their influence in a very pervasive manner.

TABLE 42.—ACCIDENT FREQUENCY AND SEVERITY RATES FOR SPECIFIED DEPARTMENTS IN THE IRON AND STEEL INDUSTRY, 1910 TO 1914, AND 1915 TO 1919, BY CAUSES.

Department.	Machinery.		Hot substances.		Falling objects.		Falls of worker.		Handling tools and objects.		Power vehicles.	
	1910-1914	1915-1919	1910-1914	1915-1919	1910-1914	1915-1919	1910-1914	1915-1919	1910-1914	1915-1919	1910-1914	1915-1919
Frequency rates (per 10,000,000 hours' exposure).												
Blast furnaces.....	39.3	28.9	193.7	82.5	128.8	36.0	58.5	37.7	89.3	110.5	10.0	28.2
Open hearths.....	78.3	65.5	143.4	126.9	135.0	58.6	50.6	45.8	100.3	143.1	34.3	32.8
Bessemer.....	69.3	33.0	170.8	73.4	199.1	42.2	46.8	28.7	103.5	80.7	31.0	30.0
Foundries.....	135.2	105.6	102.0	55.5	100.8	78.0	31.3	25.1	164.7	180.0	3.0	6.8
Tube mills.....	135.8	35.2	65.7	16.0	105.5	18.9	32.3	11.2	139.9	65.4	5.0	2.7
Heavy rolling mills.....	86.1	55.5	40.0	30.1	90.4	38.8	32.7	25.0	104.9	95.8	12.0	7.5
Plate mills.....	137.9	84.3	55.8	36.8	176.0	68.4	45.0	27.2	128.9	140.7	15.0	4.5
Sheet mills.....	78.2	41.1	28.1	22.0	52.7	22.6	28.3	22.5	113.6	220.7	10.7	.....
Fabricating.....	294.1	158.7	22.2	12.3	201.6	50.1	61.7	28.2	181.0	122.7	2.3	3.9
Mechanical.....	136.4	85.9	37.6	24.8	131.7	52.4	46.6	39.6	129.4	146.7	10.0	7.1
Yards.....	50.1	34.3	22.7	17.3	97.4	35.2	37.3	24.8	90.3	101.8	99.0	165.3
Severity rates (per 10,000 hours' exposure).												
Blast furnaces.....	10.8	14.5	29.7	18.5	8.6	5.5	15.7	7.4	3.3	4.0	10.4	19.0
Open hearths.....	13.8	19.3	15.8	16.7	6.0	8.1	5.0	1.0	1.7	3.6	10.5	11.8
Bessemer.....	12.3	16.8	28.7	24.0	13.8	8.6	4.1	1.4	3.0	2.3	79.0	13.5
Foundries.....	14.4	13.1	5.3	7.0	14.8	5.8	4.2	2.5	2.6	4.4	1.1	.1
Tube mills.....	11.4	12.3	.9	2.2	4.0	.7	2.6	2.1	1.9	4.1	2.1	.8
Heavy rolling mills.....	11.4	10.7	9.2	5.7	4.2	1.7	2.5	.6	2.9	2.8	.6	5.9
Plate mills.....	16.1	12.7	6.1	3.1	6.6	1.9	.6	2.4	1.7	2.5	4.2	.1
Sheet mills.....	15.4	12.3	.4	2.2	.8	.7	1.8	2.1	2.7	4.1	8.0	.8
Fabricating.....	30.9	18.6	.2	2.0	8.7	3.1	5.4	2.3	2.9	2.0	1.8	.1
Mechanical.....	12.0	11.2	4.3	2.8	9.7	2.5	11.4	4.9	3.0	5.3	2.8	2.8
Yards.....	6.8	13.6	5.5	.3	2.9	2.9	2.2	.4	2.9	3.4	25.4	54.4

Table 43 presents a more extended analysis of accident causes and shows how they have been changing from year to year since 1913. A very characteristic hazard of the iron and steel business is that from hot substances. This has gone from 5.4 cases per 1,000,000 hours' exposure in 1913 to 1.2 in 1921, a drop of 78 per cent. Handling objects and tools is nearly always the cause of the greatest number of accidents. The accident rates from this cause have gone from 26.7 cases in 1913 to 6.5 in 1921, a decline of 76 per cent. It should be noticed that probably not all of this decline can be attributed to the development of the safety movement. The year 1921 was a depressed industrial year, while 1913 was a year of exceptional industrial activity. The decline of the entire group from 1913 to 1921 was 78 per cent, while the drop from 1913 to 1920 was 64 per cent. The years 1913 and 1920 are each years of rather tense industrial conditions. It is probable that the 64 per cent drop represents more exactly the influence of safety effort than does the larger figure.

TABLE 43.—ACCIDENT FREQUENCY RATES (PER 1,000,000 HOURS' EXPOSURE) IN THE IRON AND STEEL INDUSTRY, 1913 TO 1921, BY ACCIDENT CAUSES.

Accident cause.	1913	1914	1915	1916	1917	1918	1919	1920	1921	Total.
Machinery.....	7.3	5.0	4.9	5.4	4.5	4.0	3.3	3.4	1.8	4.4
Working machines.....	3.8	2.7	2.6	2.6	2.0	1.8	1.4	1.5	.8	2.1
Caught in.....	2.5	1.8	1.7	1.7	1.2	1.1	.9	1.0	.6	1.4
Breakage.....	.1	.1	.1	.1	.7	.1	.1	.1	.06	.1
Moving material in.....	1.2	.8	.8	.8	.7	.6	.4	.4	.1	.6
Cranes.....	3.5	2.3	2.3	2.8	2.5	2.2	1.9	1.9	1.0	2.3
Overhead.....	2.8	1.9	2.0	2.5	2.2	1.9	1.6	1.5	.2	1.9
Locomotive.....	.3	.2	.2	.2	.2	.2	.2	.2	.2	.2
Other hoisting.....	.4	.2	.1	.1	.1	.1	.1	.2	.7	.2
Vehicles.....	2.3	1.9	1.6	1.7	1.7	1.3	1.2	1.1	.5	1.5
Hot substances.....	5.4	3.6	3.7	4.5	3.6	3.0	2.8	2.5	1.2	3.4
Electricity.....	.5	.4	.2	.4	.3	.3	.2	.3	.1	.3
Hot metal.....	3.6	2.1	2.2	3.0	2.5	2.1	2.0	1.8	.8	2.3
Hot water, steam, etc.....	1.3	1.1	1.2	1.1	.8	.6	.6	.4	.2	.8
Falls of persons.....	4.5	4.1	3.5	3.7	3.2	2.8	2.8	2.5	1.7	3.2
From ladders.....	.3	.1	.1	.2	.1	.2	.1	.1	.09	.1
From scaffolds.....	.2	.2	.2	.2	.3	.2	.2	.2	.1	.2
Into openings.....	.2	.1	.1	.3	.2	.1	.1	.1	.07	.1
Due to insecure footing.....	3.8	3.7	3.1	3.1	2.6	2.3	2.3	2.1	1.4	2.7
Falling material, not otherwise specified.....	1.2	.7	.7	.6	.4	.3	.4	.4	.1	.5
Handling objects and tools.....	26.7	19.4	20.6	21.5	15.7	12.8	11.7	10.4	6.5	16.0
Objects dropped in handling.....	11.2	7.3	7.6	8.4	6.1	5.5	5.0	4.4	2.6	6.4
Caught between object handled and other object.....	3.4	2.6	2.6	3.1	2.1	1.7	1.7	1.3	.7	2.1
Trucks and barrows.....	1.9	1.0	1.4	1.4	1.2	.9	.7	.6	.5	1.1
Lifting or pulling.....	2.5	2.3	2.5	2.5	2.0	1.4	1.4	1.1	.8	1.8
Objects flying from tools.....	.2	.2	.1	.1	.1	.1	.1	.1	.07	.1
Slivers and edges.....	3.8	3.4	3.8	3.1	2.2	1.5	1.3	1.5	1.1	2.4
Using tools.....	3.7	2.6	2.6	2.9	2.0	1.7	1.4	1.4	.8	2.1
Miscellaneous.....	12.9	8.8	6.5	7.0	5.4	4.6	4.1	3.1	1.3	5.5
Asphyxiating gas.....	.3	.2	.1	.1	.1	.1	.2	.1	.5	.1
Flying objects not striking eye.....	.8	.6	.6	.5	.4	.5	.3	.3	.2	.4
Flying objects striking eye.....	2.9	2.1	1.7	1.9	1.6	1.6	1.3	1.1	.5	1.6
Heat cramps, etc.....	.9	.8	.4	.4	.1	.2	.1	.1	.06	.3
Other causes.....	8.0	5.1	3.7	4.1	3.2	2.2	2.2	1.5	.6	3.0
Total.....	60.3	43.5	41.5	44.4	34.5	28.8	26.3	22.0	13.3	34.5

MINES, QUARRIES, AND METALLURGICAL WORKS.

COAL MINES.

The Bureau of Mines publishes annual statements regarding coal mines, metal mines, quarries, coke ovens, and metallurgical works, presenting the facts in detail. The data as to these industries here-with presented are taken from these reports.

Table 44 summarizes the facts regarding number of employees, average production per man, and fatalities in coal mines from 1907 to 1921.

There are two things which it is desirable to know regarding any such record: (1) Does it represent increasing or decreasing hazard to the men employed? (2) Is the production cost due to accidents going up or down? It has been usual to express the fatality rate for mining operations in terms of the deaths "per million tons mined." Any such expression standing by itself should be, as it has been, severely criticised. An increase in output accompanied by a serious rise in fatality is the securing of results at too great a cost.

In Table 44 are presented both phases of the matter. The fatality rate for coal mines has irregularly but quite steadily declined. From 1907 to 1921 there was a drop of 34 per cent. In the meantime production per death rose 71 per cent. Evidently coal mining is being conducted in a manner which is both less dangerous to the miners and more efficient in getting out the coal than was the case in 1907.

TABLE 44.—NUMBER OF MEN EMPLOYED, AVERAGE PRODUCTION PER MAN, MEN KILLED, AND FATALITY RATES IN COAL MINES IN THE UNITED STATES, 1907 TO 1921.

Year.	Men employed.		Average production per man (tons).		Men killed.	Fatality rate (per 1,000,000 hours' exposure).	Production per death (short tons).
	Actual number.	Equivalent full-year workers.	Per year.	Per day.			
1907.....	680,492	523,979	708	3.06	3,242	2.06	147,407
1908.....	690,438	448,785	603	3.09	2,445	1.82	167,407
1909.....	666,552	.....	691	.....	2,642	.....	174,416
1910.....	725,030	531,689	692	3.15	2,821	1.77	177,808
1911.....	728,348	534,122	682	3.10	2,656	1.66	186,887
1912.....	722,662	541,997	740	3.29	2,419	1.49	220,945
1913.....	747,644	593,131	762	3.20	2,785	1.57	204,685
1914.....	763,185	526,598	673	3.25	2,454	1.55	209,261
1915.....	734,008	511,598	724	3.46	2,269	1.48	234,197
1916.....	720,971	565,766	818	3.48	2,226	1.31	265,094
1917.....	757,317	634,666	860	3.43	2,696	1.42	241,618
1918.....	762,426	664,973	890	3.45	2,580	1.31	262,873
1919.....	776,569	542,217	713	3.41	2,314	1.42	239,082
1920.....	780,000	626,667	827	3.43	2,271	1.21	234,308
1921.....	750,000	.....	.....	.....	1,973	1.20	251,124

In Table 45 are presented the place of occurrence and the cause of the fatal accidents in coal mines in the years 1916 to 1921. The serious danger in mines, as shown very conspicuously by this table, is falling material from roof or face, accounting for nearly half of all the accidents, and there is practically no decline in fatalities from this cause from year to year. This fact of no decline in the most serious menace to mine workers in the period is much more evident when fatality rates are calculated for the several causes. Such rates, based on the number of full-year workers shown in Table 44, are also presented in Table 45.

It would be advantageous if the number of employees working both underground and on the surface were known, so that separate fatality rates could be computed. Undoubtedly the rates for the underground workers would be higher and those for the surface group lower than those shown for all employees. It is not possible, with the data available, to compute such rates.

It would seem from a consideration of the fatality rates for the various accident causes in coal mining shown in Table 45 that the industry as a whole has been at a standstill in the matter of safety during recent years, conditions neither improving nor getting worse. Some of the progressive companies, however, are showing accident reductions quite comparable with those secured in manufacturing.

TABLE 45.—FATALITIES AT COAL MINES IN THE UNITED STATES, 1916 TO 1921, BY PLACE OF OCCURRENCE AND CAUSE.

Place of occurrence and accident cause.	1916	1917	1918	1919	1920	1921
Number of fatalities.						
Underground:						
Material falling from roof or face.....	1,065	1,147	1,294	1,100	1,132	1,019
Mine cars and locomotives.....	390	482	506	381	408	338
Gas and dust explosions.....	226	199	129	191	164	115
Explosives.....	146	111	135	206	128	152
Electricity.....	90	79	88	69	76	80
Miscellaneous underground.....	110	361	129	130	112	116
Total underground.....	2,027	2,379	2,281	2,077	2,020	1,820
Shaft.....	49	52	52	52	56	36
Surface:						
Haulage.....	75	114	118	91	73	44
Machinery.....	22	51	47	28	29	17
Miscellaneous.....	53	100	82	66	88	56
Total surface.....	150	265	247	185	195	117
Grand total.....	2,226	2,696	2,580	2,314	2,271	1,973
Fatality rates (per 1,000,000 hours' exposure).¹						
Underground:						
Material falling from roof or face.....	0.63	0.60	0.66	0.67	0.60	0.62
Mine cars and locomotives.....	.23	.25	.26	.23	.22	.21
Gas and dust explosions.....	.13	.10	.07	.12	.09	.07
Explosives.....	.09	.06	.06	.13	.06	.09
Electricity.....	.05	.05	.04	.05	.04	.05
Miscellaneous.....	.07	.19	.07	.08	.06	.06
Total underground.....	1.19	1.25	1.16	1.28	1.07	1.10
Shaft.....	.03	.03	.03	.03	.03	.02
Surface:						
Haulage.....	.04	.06	.06	.06	.04	.03
Machinery.....	.01	.03	.03	.02	.02	.02
Miscellaneous.....	.03	.05	.03	.03	.05	.03
Total surface.....	.09	.14	.12	.11	.11	.08
Grand total.....	1.31	1.42	1.31	1.42	1.21	1.20

¹ The rates above become comparable with those on the basis of full-year workers when multiplied by 3.

Table 46 affords an interesting comparison between the hazard of coal mining and that of railway operation. It would appear that on the whole coal mining presents less hazard than does train operation. The common opinion to the contrary is a natural outcome of the fact that mining casualties come from time to time in sudden catastrophes which sometimes involve hundreds of men and excite prolonged interest on account of rescue effort, while the railwayman meets his hazard as an individual, the total railway accidents being the accumulated result of many single accidents.

TABLE 46.—COAL-MINE FATALITIES VERSUS STEAM-RAILWAY FATALITIES: FATALITY RATES (PER 1,000 EMPLOYEES), 1909 TO 1918.

Year.	Fatality rates (per 1,000 employees).			Year.	Fatality rates (per 1,000 employees).		
	Underground workers in Pennsylvania coal mines.		Railway trainmen.		Underground workers in Pennsylvania coal mines.		Railway trainmen.
	Anthracite.	Bituminous.			Anthracite.	Bituminous.	
1909.....	3.97	3.12	4.87	1914.....	3.98	2.33	4.73
1910.....	4.19	3.03	5.41	1915.....	4.01	2.61	3.53
1911.....	4.88	3.23	5.49	1916.....	4.28	2.92	4.07
1912.....	3.90	2.73	5.22	1917.....	4.27	3.13	4.23
1913.....	4.33	3.59	5.05	1918.....	4.35	3.10	4.29

METAL MINES.

Table 47 presents the facts regarding the number of employees and fatal and nonfatal accidents in the different kinds of metal mines for the years 1917 to 1920. It is not possible from this table to get much idea of the course of accident occurrence during these years, but the table is of interest because it indicates the relative importance of the various forms of metal mining.

TABLE 47.—NUMBER OF MEN EMPLOYED AND NUMBER KILLED AND INJURED IN METAL MINES IN THE UNITED STATES, 1917 TO 1920, BY KIND OF MINE.

Kind of mine.	Active operators.	Men employed.			Men killed.			Men injured (time lost more than 1 day).		
		Under-ground.	Surface.	Total.	Under-ground.	Surface.	Total.	Under-ground.	Surface.	Total.
1917.										
Copper.....	649	43,715	17,560	61,275	1,352	22	374	16,532	3,403	19,935
Gold, silver, and miscellaneous metal.....	3,166	35,812	16,080	51,892	166	30	196	7,144	1,241	8,385
Iron.....	205	31,549	25,681	57,230	135	56	191	8,872	3,406	12,278
Lead and zinc (Mississippi Valley).....	369	15,075	5,194	20,269	65	3	68	3,777	767	4,544
Nonmetallic mineral.....	248	2,726	7,187	9,913	9	14	23	430	714	1,144
Total.....	4,637	128,877	71,702	200,579	727	125	852	36,755	9,531	46,286
1918.										
Copper.....	524	42,286	17,161	59,447	180	40	220	17,201	3,312	20,513
Gold, silver, and miscellaneous metal.....	2,429	28,061	15,582	43,643	152	29	181	5,429	2,418	7,847
Iron.....	176	28,775	24,890	53,665	128	51	179	6,853	2,763	9,621
Lead and zinc (Mississippi Valley).....	236	10,344	3,660	14,004	43	4	47	3,145	601	3,746
Nonmetallic mineral.....	271	2,690	9,157	11,847	10	9	19	334	854	1,188
Total.....	3,636	112,156	70,450	182,606	513	133	646	32,967	9,948	42,915
1919.										
Copper.....	410	27,298	12,029	39,327	120	20	140	10,002	2,234	12,236
Gold, silver, and miscellaneous metal.....	2,430	21,868	10,262	32,130	113	13	126	4,656	813	5,469
Iron.....	157	28,234	19,442	47,676	107	32	139	6,967	2,191	9,098
Lead and zinc (Mississippi Valley).....	141	10,075	2,893	12,968	42	3	45	2,822	363	3,185
Nonmetallic mineral.....	245	3,356	9,805	13,161	5	12	18	414	1,104	1,518
Total.....	3,383	90,831	54,431	145,262	388	80	468	24,801	6,705	31,506
1920.										
Copper.....	387	23,671	11,853	35,254	107	21	128	9,624	2,423	12,047
Gold, silver, and miscellaneous metal.....	2,358	20,077	9,856	29,933	100	17	117	4,794	910	5,704
Iron.....	154	25,627	20,363	45,990	86	20	106	6,734	2,338	9,072
Lead and zinc (Mississippi Valley).....	119	8,861	2,777	11,638	33	3	36	3,223	384	3,607
Nonmetallic mineral.....	263	3,149	10,619	13,768	8	30	38	571	1,561	2,132
Total.....	3,281	81,385	55,198	136,583	334	91	425	24,946	7,616	32,562

¹ Includes 161 fatalities due to the North Butte mine fire, Butte, Mont.

In Table 48 accident rates for all metal mines combined are computed for the years 1911 to 1920. The rates for injury show a tendency to increase, which is probably due to more complete reporting. On the other hand, fatality rates show a tendency to decline, which is significant, since deaths have probably been quite uniformly reported during the period. The fatality rates for underground workers declined from 1.83 cases per 1,000,000 hours' exposure in 1911 to 1.39 in 1920, or 24 per cent. The surface workers had a fatality rate scarcely one-half of the rate for underground workers during the entire period. The decline in fatality rates for surface workers was from 0.88 per 1,000 hours' exposure in 1911 to 0.56 in 1920, or 37 per cent.

TABLE 48.—NUMBER OF FULL-YEAR WORKERS AND ACCIDENT FREQUENCY RATES FOR METAL MINES IN THE UNITED STATES (PER 1,000,000 HOURS' EXPOSURES), 1911 TO 1920.

Year.	Equivalent of full-year workers.			Accident frequency rates (per 1,000,000 hours' exposure).					
				Men killed.			Men injured.		
	Under-ground.	Surface.	Total.	Under-ground.	Surface.	Total.	Under-ground.	Surface.	Total.
1911.....	98,389	57,700	156,089	1.83	.88	1.48	72.43	30.03	56.76
1912.....	105,153	56,509	161,662	1.65	.82	1.39	78.81	34.65	63.37
1913.....	121,293	62,300	183,593	1.51	.72	1.24	70.15	39.54	59.85
1914.....	91,659	50,909	142,619	1.70	.61	1.31	87.27	40.68	70.62
1915.....	89,821	52,176	141,997	1.67	.65	1.30	106.62	41.95	82.85
1916.....	125,601	66,854	192,455	1.52	.61	1.21	102.04	48.80	83.55
1917.....	126,815	65,270	192,085	1.91	.64	1.48	96.61	48.67	80.32
1918.....	113,441	67,565	181,006	1.51	.66	1.19	96.87	49.08	79.03
1919.....	85,769	50,513	136,282	1.51	.53	1.14	96.39	44.25	77.06
1920.....	80,215	54,325	134,540	1.39	.56	1.05	103.66	43.73	80.67

QUARRIES.

In Table 49, which sets forth the number of men employed and accident frequency rates for quarries during two 5-year periods, a very slight improvement is noted in the fatality rate for the 5-year period 1916 to 1920 over that for 1911 to 1915. The accident rate for injuries increased up to the year 1917 and slightly declined thereafter. The increase, as pointed out before, is very probably due to more complete reporting and not to greater hazard.

TABLE 49.—NUMBER OF MEN EMPLOYED, NUMBER OF MEN KILLED AND INJURED, AND ACCIDENT FREQUENCY RATES FOR QUARRIES IN THE UNITED STATES, 1911 TO 1920.

Year.	Men employed.		Men killed.	Men injured.	Frequency rates (per 1,000,000 hours' exposure).	
	Actual number.	Equivalent full-year workers.			Men killed.	Men injured.
	1911.....	110,954	84,417	188	5,390	0.74	21.28
1912.....	113,105	93,837	213	6,532	.76	23.67
1913.....	106,278	87,141	183	7,739	.70	29.60
1914.....	87,936	68,187	180	7,836	.88	38.31
1915.....	100,740	82,447	148	9,671	.60	39.10
Average, 5 years.....	103,803	83,206	182	7,437	.73	29.80
1916.....	90,707	76,457	173	13,427	.75	58.54
1917.....	82,290	71,525	131	13,242	.61	61.71
1918.....	68,332	59,285	125	8,719	.70	49.02
1919.....	75,505	63,794	123	9,199	.64	48.07
1920.....	86,488	77,089	178	11,217	.77	48.50
Average, 5 years.....	80,682	69,630	146	11,161	.70	53.43
Average, 10 years.....	92,243	76,418	164	9,299	.72	40.56

METALLURGICAL PLANTS.

Table 50, embodying the accident experience of metallurgical plants from 1913 to 1920, covers ore dressing, smelting, and auxiliary plants. Of these smelting has the highest rates both for fatalities and for injuries. Rates for fatalities declined 64 per cent and those for injury 19 per cent.

TABLE 50.—NUMBER OF MEN EMPLOYED, NUMBER OF MEN KILLED AND INJURED, AND ACCIDENT FREQUENCY RATES FOR METALLURGICAL PLANTS IN THE UNITED STATES, 1913 TO 1920.

Kind of plants and year.	Men employed.		Men killed.	Men injured.	Frequency rates (per 1,000,000 hours' exposure.)	
	Actual number.	Equivalent full-year workers.			Men killed.	Men injured.
Ore-dressing plants:						
1913.....	14,985	16,154	16	1,977	0.33	40.79
1914.....	15,128	15,225	23	1,434	.50	31.40
1915.....	18,564	19,107	30	2,095	.52	36.55
1916.....	22,365	23,470	33	3,184	.47	45.22
1917 ¹	24,111	24,372	47	2,952	.64	40.37
1918 ¹	21,809	22,517	35	3,142	.55	46.51
1919 ¹	17,262	16,862	25	2,057	.49	40.74
1920 ¹	15,959	15,977	21	2,624	.44	54.75
Smelting plants:²						
1913.....	20,564	24,309	47	4,247	.64	58.24
1914.....	27,879	32,336	33	5,673	.34	58.48
1915.....	31,327	36,262	38	5,718	.35	52.56
1916.....	43,829	49,363	36	9,656	.24	65.20
1917 ¹	44,376	50,659	53	7,745	.35	50.96
1918 ¹	39,899	45,439	42	6,743	.31	49.47
1919 ¹	28,777	31,324	34	4,431	.36	47.15
1920 ¹	24,944	29,137	20	4,147	.23	47.44
Auxiliary works:						
1913, 1914, 1915 ³	14,007	15,763	14	2,240	.30	47.37
1916.....	15,555	17,014	16	2,881	.31	56.44
1917.....	18,044	20,111	17	2,808	.28	46.54
1918.....	15,081	16,172	5	1,638	.10	33.76
1919.....	16,005	18,005	20	2,092	.37	38.73

¹ Not including auxiliary works, as shops, yards, etc.

² Exclusive of iron blast furnaces.

³ Not separately reported.

COKE OVENS.

Table 51 gives accident data for coke ovens as a unit. This is not wholly desirable since there are two processes, the beehive and the by-product, whose hazards are materially different. So far, however, as the data presented indicates the situation, the accident frequency rates fluctuate irregularly, with no particular tendency either upward or downward.

When these rates are compared with those in Table 39, which are for certain by-product coke ovens operated in connection with steel mills, it will be noted that the by-product ovens have on the whole higher rates but that their rates show much more improvement. This suggests that possibly some coke ovens have not come within the influence of the safety movement to the same extent as have those associated with the steel mills.

TABLE 51.—NUMBER OF MEN EMPLOYED, FATALITIES, AND INJURIES, AND ACCIDENT FREQUENCY RATES FOR COKE OVENS IN THE UNITED STATES, 1915 TO 1921.

Year.	Men employed.		Men killed.	Men injured.	Frequency rates (per 1,000,000 hours' exposure.)	
	Actual number.	Equivalent full-year workers.			Men killed.	Men injured.
1915.....	31,060	31,415	38	2,852	0.40	30.26
1916.....	31,603	34,119	45	5,237	.44	51.16
1917.....	32,417	35,595	76	6,713	.71	62.86
1918.....	32,389	35,476	73	7,792	.69	73.21
1919.....	28,741	27,674	53	4,031	.64	48.55
Average for 5 years.....	31,242	32,856	57	5,325	.58	54.02
1920.....	28,139	29,921	49	3,415	.55	38.04
1921.....	16,204	13,868	17	1,853	.41	44.54

MISCELLANEOUS INDUSTRIES.

From time to time the Bureau of Labor Statistics has secured from various sources such accident reports as were available from industrial groups which were of sufficient size to be significant. The data for the following industries are presented because they were in condition to be readily put into standard form. Others of equal significance are omitted, since it was either impossible to put the data as to them into standard form or else to do so would require too much time.

No attempt has been made to include entire industries, but an effort has been made in each case to secure a volume of records of sufficient size to be fairly representative. The nearest approach to data for entire industries will be found in the section devoted to State accident data (pp. 8 to 23). Since only 22 States publish an industrial classification and some of the largest, such as New York and Ohio, have not recently published any extended statistics, it is evident that completeness is impossible.

It should be noted that practically all of the data of the industrial concerns here included are available because such concerns have made a good record in accident prevention. They represent some of the most successful efforts thus far made in the field of accident prevention. This is from some viewpoints an advantage. While the average attainment of an industry is a fair standard to insist upon for all units of that industry, yet it is worth while at times to present such unusual results as are attained by the best organizations. These indicate what may be done by the highest skill and the most perfect organization yet attained, and after all the best is none too good.

AGRICULTURAL MACHINERY AND SUPPLIES.

Table 52 gives the number of full-year workers, number of accidents, and frequency and severity rates for the agricultural machinery and supplies industry, and represents, as the number of full-year workers indicates, a very substantial portion of such industry.

TABLE 52.—NUMBER OF FULL-YEAR WORKERS, NUMBER OF ACCIDENTS, AND ACCIDENT FREQUENCY AND SEVERITY RATES FOR THE AGRICULTURAL MACHINERY AND SUPPLIES INDUSTRY, 1912 TO 1921.

Operation and year.	Equivalent number of full-year workers.	Number of accidents.	Frequency rates (per 1,000,000 hours' exposure).	Severity rates (per 1,000 hours' exposure).
Agricultural machinery, general manufacture:				
1912.....	23,118	5,433	78.34	1.80
1913.....	22,832	4,894	71.45	2.64
1914.....	13,955	1,571	37.53	1.64
1915.....	13,654	1,059	25.85	1.80
1916.....	16,168	1,826	37.65	2.33
1917.....	19,457	2,354	39.92	2.15
1918.....	20,152	2,094	34.64	2.29
1919.....	18,652	1,668	29.81	2.07
1920.....	23,136	2,059	29.67	2.34
1921.....	9,077	580	21.30	1.05
Operation of woodworking machines:				
1912.....	1,925	372	64.41	2.06
1913.....	1,858	315	56.52	2.84
1914.....	1,179	108	30.55	1.87
1915.....	1,064	82	25.70	1.58
1916.....	1,191	122	34.14	5.02
1917.....	1,576	184	38.92	1.22
1918.....	1,707	197	38.47	2.99
1919.....	1,571	123	26.10	1.35
1920.....	1,589	125	26.22	1.70
1921.....	652	38	19.44	5.11
Manufacture of binder twine:				
1912.....	2,875	525	60.87	1.37
1913.....	2,753	394	47.71	2.69
1914.....	2,401	296	41.09	2.85
1915.....	2,305	186	26.90	.58
1916.....	2,828	205	24.16	1.80
1917.....	2,114	191	30.11	.69
1918.....	2,493	153	20.45	2.39
1919.....	1,844	73	13.19	.73
1920.....	2,166	121	18.62	.76
1921.....	1,606	81	16.32	.45

The frequency rates show a very consistent decline between 1912 and 1921, those for general manufacture declining from 78.3 to 21.3 per 1,000,000 hours' exposure, or 73 per cent, while in woodworking the decline was 71 per cent and in the manufacture of binder twine 72 per cent.

The severity rates are more irregular. This is likely to be the case unless the exposure is very large, being due to the necessarily considerable influence on the rates of the more serious injuries, such as those causing death. These happen with relative infrequency but weight the severity heavily when they do happen.

The decline in general manufacture in accident severity is from 1.80 days per 1,000 hours' exposure in 1912 to 1.05 in 1921, or 42 per cent. If 1912 and 1921 be compared, woodworking will appear to have increased its severity rate. This is evidently due to the small exposure in the latter year and the occurrence of death. If 1913 and 1920 are considered, there was a 40 per cent decline.

The manufacture of binder twine registers a decline in accident severity rates of 85 per cent from 1914, when severity was highest (2.86 days), to 1921, when severity was lowest (0.45 days).

AUTOMOBILE INDUSTRY.

The accident data for January to June, 1922, presented in Table 53 cover a very large fraction of the workers engaged in the production of automobiles. The accident rates, both frequency and severity,

are low. On the whole, accident frequency was increasing and accident severity decreasing, the rise in frequency probably being closely related to the fact that the period covered was one in which there was a constantly augmented number of workers.

TABLE 53.—NUMBER OF ACCIDENTS AND FREQUENCY AND SEVERITY RATES IN THE MANUFACTURE OF AUTOMOBILES, JANUARY TO JUNE, 1922.

Group A.

Period.	Hours of exposure. (thousands).	Number of accidents.	Frequency rate (per 1,000,000 hours' exposure).	Severity rate (per 1,000 hours' exposure).
January, 1922.....	5,672	120	21.17	0.34
February, 1922.....	6,333	157	24.79	.60
March, 1922.....	7,749	203	26.21	.36
22 months to March, 1922.....	141,761	3,861	27.2	.56

Group B.

Month.	Days in operation.	Number of workers.	Number of accidents.	Frequency rate (cases per 1,000,000 hours' exposure).	Severity rate (per 1,000 hours' exposure).
January, 1922.....	14	37,766	34	8.43	0.79
February, 1922.....	16	36,792	34	7.22	.06
March, 1922.....	20	37,296	59	9.89	.58
April, 1922.....	25	41,766	91	11.43	.30
May, 1922.....	26	45,946	114	12.51	.47
June, 1922.....	26	49,850	131	13.25	.23

BUILDING CONSTRUCTION.

The accident data in Table 54 are for three groups of building construction workers. This sort of work presents difficulties regarding safety not to be found in industries which have a local habitation, as many of the appliances are of a temporary nature and must be transported with every new project, which makes it difficult to give them the proper oversight; also, there is nearly always some pressure for haste. The comparison in Table 54 is therefore important as it demonstrates that in this difficult field the same sort of effort which has been effective elsewhere will produce results.

The three groups are not strictly comparable since Groups A and C include a greater proportion of operations of a hazardous character than Group B. The significant thing is that Group A in a three-year period cut accident frequency 5 per cent and accident severity 44 per cent, showing that while construction is characterized by a high proportion of severe injury it is particularly amenable to those improvements included under "engineering revision."

TABLE 54.—NUMBER OF FULL-YEAR WORKERS, NUMBER OF ACCIDENTS, AND ACCIDENT FREQUENCY AND SEVERITY RATES IN BUILDING CONSTRUCTION, 1919 TO 1921.

Year.	Hours of exposure (thousands).	Equivalent full-year workers.	Number of accidents.	Frequency rates (per 1,000,000 hours' exposure).	Severity rates (per 1,000 hours' exposure).
Group A:					
1919.....	4,140	1,380	216	52.2	6.1
1920.....	7,635	2,545	300	39.3	10.1
1921.....	3,695	1,232	184	49.8	3.4
Group B: 1					
1919.....	14,788	4,929	247	16.7	3.1
1920.....	11,362	3,787	177	15.6	1.2
Group C: 2					
Year ending June 30, 1920.....	10,025	3,342	519	51.8	3.3
Four months ending Sept. 30, 1920....	2,291	764	82	35.8	.8

¹ National Safety News, August, 1921, p. 23.² Idem, Mar. 21, 1921, p. 13.

COPPER WORKS.

Table 55 contrasts two rather widely separated years in the accident experience of a copper works. The years given are favorable for comparison because they were both years of rather high industrial activity and because the amount of exposure was practically the same in each. Accident frequency declined 75 per cent and severity 81 per cent.

TABLE 55.—NUMBER OF FULL-YEAR WORKERS, NUMBER OF ACCIDENTS, AND ACCIDENT FREQUENCY AND SEVERITY RATES IN A COPPER WORKS, FISCAL YEARS 1913 AND 1920.¹

Year ending—	Hours of exposure (thousands).	Equivalent full-year workers.	Number of accidents.	Frequency rates (per 1,000,000 hours' exposure).	Severity rates (per 1,000 hours' exposure).
Aug. 31, 1913.....	2,815	938	236	83.9	3.2
Nov. 30, 1920.....	2,985	995	63	21.1	.6

¹ National Safety News, Mar. 28, 1921, p. 8.

ELECTRICAL APPARATUS.

In Table 56 is recorded the accident experience of the electrical apparatus manufacturing industry for the year 1920 and six months of the year 1921. Accident frequency drops between the two periods 47 per cent while accident severity goes down 54 per cent. The exposure is not sufficient to be very impressive, but the declining rates are another evidence of the possible results of serious safety effort.

TABLE 56.—NUMBER OF FULL-YEAR WORKERS, NUMBER OF ACCIDENTS, AND ACCIDENT FREQUENCY AND SEVERITY RATES IN THE MANUFACTURE OF ELECTRICAL APPARATUS, 1920 AND JANUARY TO JUNE, 1921.¹

Year.	Hours of exposure (thousands).	Equivalent full-year workers.	Number of accidents.	Frequency rates (per 1,000,000 hours' exposure).	Severity rates (per 1,000 hours' exposure).
1920.....	4,926	1,642	51	10.4	.35
1921, January 1 to June 30.....	1,986	662	11	5.5	.16

¹ National Safety News, December, 1921, p. 34.

EXPLOSIVES, DYES, AND CHEMICALS.

Table 57 presents an extended showing of the accident experience of a company which is a large producer of explosives and other chemical products. The first part of the table contrasts the accident occurrence in two industrially active years. In the earlier year safety activity in the modern sense had scarcely gotten a foothold. The severity rate of 1910 (14.43 days) will at once be seen to be among the extraordinarily high rates such as those of the erection of structural steel, railway brakemen, and logging. After a decline of 75 per cent from 1910, the rate in 1920 (3.67 days) is no longer conspicuously high.

The second part of the table presents fatality rates from 1908 to 1920 and nonfatal-accident rates from 1915 to 1920, in both of which there was a remarkable decline. From 1908 to 1920 the fatality frequency rates went down 86 per cent, while from 1916 to 1920 nonfatal frequency rates dropped 55 per cent. This is the more remarkable when it is noted that the company expanded enormously from 1914 to 1918. Nothing but most intense and effective safety effort could have accomplished this result in such a highly hazardous industry.

TABLE 57.—NUMBER OF FULL-YEAR WORKERS, NUMBER OF ACCIDENTS, AND ACCIDENT FREQUENCY AND SEVERITY RATES IN THE MANUFACTURE OF EXPLOSIVES, DYES, AND CHEMICALS, 1908 TO 1920.¹

Year.	Hours of exposure (thousands).	Equivalent full-year workers.	Number of accidents.	Frequency rates (per 1,000,000 hours' exposure).	Severity rates (per 1,000 hours' exposure).
1910.....	14,070	4,690	430	30.57	14.43
1920.....	48,396	16,132	813	16.80	3.67

	Hours of exposure (thousands).	Equivalent full-year workers.	Frequency rates (per 1,000,000 hours' exposure).		
			Fatal accidents.	Nonfatal accidents.	Total.
1908.....	9,963	3,321	3.50	.....	.....
1909.....	12,129	4,043	2.06	.....	.....
1910.....	14,070	4,690	2.20	.....	.....
1911.....	14,184	4,723	1.20	.....	.....
1912.....	13,719	4,573	.80	.....	.....
1913.....	12,873	4,291	1.71	.....	.....
1914.....	12,399	4,133	.57	.....	.....
1915.....	160,398	53,466	.59	25.87	26.46
1916.....	112,581	37,527	1.07	36.05	37.12
1917.....	119,202	39,734	.43	35.33	35.76
1918.....	195,405	65,135	.46	25.69	26.15
1919.....	51,624	17,208	.41	18.22	18.63
1920.....	48,396	16,132	.50	16.30	16.80

¹ National Safety News, Feb. 21, 1921, p. 4.

LIGHT AND POWER.

The data in Table 58 for Group A cover the 5-year accident experience of a light and power company. Prior to 1920 accident severity rates had fallen, but in that year, because of an increase in fatalities, they shot up. From 1920 on there was a remarkable decline in both frequency and severity rates. Group B had a much

larger exposure, and while quite similar in the matter of frequency, shows a much lower severity rate, due to the relatively less fatality. The severity rates of Group A suggest that there is room for very careful further study of possible safeguards.

TABLE 58.—NUMBER OF FULL-YEAR WORKERS, NUMBER OF ACCIDENTS, AND ACCIDENT FREQUENCY AND SEVERITY RATES IN A LIGHT AND POWER COMPANY, 1918 TO 1922.

Year.	Hours of exposure (thousands).	Equivalent full-year workers.	Number of accidents.	Number of deaths.	Frequency (per 1,000,000 hours' exposure).	Severity (per 1,000 hours' exposure).
Group A: ¹						
1918.....	2,059	686	74	3	35.9	9.08
1919.....	2,059	686	69	2	33.5	6.23
1920.....	2,100	700	123	7	58.6	20.90
1921.....	1,931	643	47	5	24.3	15.90
1922.....	2,317	772	31	2	13.3	5.40
Group B: 1921.....	16,800	5,600	387	5	22.8	2.00

¹ National Safety News, February, 1923, p. 33.

MACHINE BUILDING.

Table 59 summarizes the study which the Bureau of Labor Statistics has made of the hazards of machine building. The data secured in 1912 were published in Bulletin No. 216, which was afterwards revised on the basis of the information secured in 1917 and issued as Bulletin No. 256. Details regarding the different kinds of machine building are found in that bulletin. The same ground was covered in 1921 and the results here presented in conjunction with data for 1912 and 1917.

The death frequency in machine building increased somewhat in 1917 as compared with 1912, but dropped again from 1917 to 1921. From 1912 to 1921 the decline was 20 per cent. The rates for non-fatal accidents go steadily down from 1913 to 1921—a decline of 46 per cent.

TABLE 59.—NUMBER OF FULL-YEAR WORKERS, NUMBER OF ACCIDENTS, AND ACCIDENT FREQUENCY RATES IN MACHINE BUILDING, 1912, 1917, AND 1921.

Year.	Equivalent full-year workers.	Number of accidents.			Accident frequency rates (per 1,000,000 hours' exposure).		
		Fatal.	Nonfatal.	Total.	Fatal.	Nonfatal.	Total
1912.....	115,703	37	13,610	13,647	0.10	39.23	39.33
1917.....	94,103	40	8,677	8,717	.13	30.73	30.86
1921.....	103,181	25	6,244	6,269	.08	20.33	20.41

MANUFACTURE OF CAMERAS.

Table 60 contrasts the accident occurrence in two 6-month periods for the manufacture of photographic cameras. These rates are naturally low, since there is in the production of cameras a large number of light and relatively nonhazardous operations. The table illustrates what can be accomplished even in such circumstances by determined effort. Accident frequency declined 30 per cent and accident severity 47 per cent.

TABLE 60.—NUMBER OF FULL-YEAR WORKERS, NUMBER OF ACCIDENTS, AND ACCIDENT FREQUENCY AND SEVERITY RATES IN THE MANUFACTURE OF PHOTOGRAPHIC CAMERAS, JANUARY TO JUNE, 1919 AND 1920.¹

Period.	Hours of exposure (thousands).	Equivalent full-year workers.	Number of accidents.	Frequency rates (per 1,000,000 hours' exposure).	Severity rates (per 1,000 hours' exposure).
January to June, 1919.....	2,994	998	44	13.2	0.30
January to June, 1920.....	3,063	1,021	30	9.2	.16

¹ National Safety News, Aug. 30, 1920, p. 7.

MANUFACTURE OF PORTLAND CEMENT.

Table 61 records in the data for Group A the experience of a large section of the Portland cement industry from 1918 to 1921. Accident frequency gradually increased during the three years from 1918 to 1920, due probably to more complete reporting, but decreased in 1921. Accident severity also increased in the first three years of the period, but took a decided drop in 1921. Safety campaigns conducted in a large number of plants in 1921 contributed to the low rates for that year. Group B is a portion of the larger Group A, data for which is introduced because it is the first to compile its data for 1922 and because of the remarkable reduction in severity.

The Portland Cement Association was among the first to gather complete accident statistics and now has a body of information which enables it to answer almost any statistical question that may arise.

TABLE 61.—NUMBER OF FULL-YEAR WORKERS, NUMBER OF ACCIDENTS, AND ACCIDENT FREQUENCY AND SEVERITY RATES IN THE MANUFACTURE OF PORTLAND CEMENT, 1918 TO 1922.

Year.	Hours of exposure (thousands).	Equivalent full-year workers.	Number of accidents.	Number of deaths.	Frequency rates (per 1,000,000 hours' exposure).	Severity rates (per 1,000 hours' exposure).
Group A: ¹						
1918.....	55,215	18,405	2,401	38	43.50	6.05
1919.....	48,743	16,248	2,225	39	45.65	7.15
1920.....	59,586	19,862	2,750	53	46.16	7.60
1921.....	62,247	20,749	2,727	44	43.81	5.82
Group B: ²						
1921.....	4,300	1,433	234	5	54.42	10.03
1922.....	4,900	1,633	283	.....	57.75	2.21

¹ Portland Cement Association: Study of Accidents, 1918; Accident Prevention Bulletin, September-October, 1920; July-August, 1921; and May-June, 1922.

² National Safety News, March, 1923, p. 24.

PAPER MILLS.

Table 62 contains figures for two groups of plants in the paper-mill industry. The data for the groups are interesting since they serve to indicate the possibilities of intensive effort in such mills. Group A are mills which belong to a company which was a pioneer in safety effort and has continued the effort to the present time. Group B includes a larger number of plants, some of which have more recently begun safety efforts.

In Group A there was a decline in accident frequency from 1918 to 1919 of 47 per cent, while in Group B, between 1920 and 1921, there was a drop of 11 per cent. In accident severity the percentages of decline were 17 and 5, respectively.

TABLE 62.—NUMBER OF FULL-YEAR WORKERS, NUMBER OF ACCIDENTS, AND ACCIDENT FREQUENCY AND SEVERITY RATES, IN PAPER MILLS, 1918 TO 1921.

Year.	Hours of exposure (thousands).	Equivalent full-year workers.	Number of accidents.	Frequency rates (per 1,000,000 hours' exposure).	Severity rates (per 1,000 hours' exposure).
Group A: ¹					
1918.....	6,240	2,080	253	40.6	1.57
1919.....	5,980	1,993	129	21.6	1.31
Group B: ²					
1920, January to June.....	39,325	13,108	1,870	47.5	3.10
1921.....	70,617	23,539	2,972	42.1	2.96

¹ National Safety News, Mar. 14, 1921, p. 10.

² Idem, Sept. 27, 1920, p. 11; April, 1922, p. 50.

PETROLEUM REFINING.

The following data,^o being for only a single year, is not as significant as those from which the trend of events can be inferred. The group covered is of sufficient size (27,010,000 hours' exposure), however, to give a fair idea of the relation of the petroleum refining industry to others in the matter of accident frequency and severity.

Hours of exposure.....	27,010,000
Equivalent full-year workers.....	9,003
Number of accidents.....	841
Frequency rates (per 1,000,000 hours' exposure).....	31.15
Severity rates (per 1,000 hours' exposure).....	1.86

RUBBER INDUSTRY.

Table 63, covering six months of 1922, is the first extended report of accident occurrence in the rubber industry which has been prepared. While it does not indicate anything regarding the trend of accident occurrence, it does afford some basis for judging the conditions of this industry as compared with others. For example, accident frequency in this industry is distinctly higher than that in automobile manufacture, and accident severity is somewhat higher. The exposure upon which the accident rates are based is 60,916,000 hours.

TABLE 63.—NUMBER OF ACCIDENTS, AND ACCIDENT FREQUENCY AND SEVERITY RATES, FOR THE RUBBER INDUSTRY, JANUARY TO JUNE, 1922.

Result of accident.	Number of cases.	Accident frequency rates (per 1,000,000 hours' exposure).	Accident severity rates (per 1,000 hours' exposure).
Death.....	1	0.02	0.10
Permanent disability.....	17	.28	.16
Temporary disability.....	2,099	34.45	.41
Total.....	2,117	34.75	.67

^o National Safety News, July, 1922, p. 31.

RUBBER TIRES.

The data as to accident occurrence given in Table 64 cover two groups of workers engaged in the manufacture of rubber tires, and are for the years 1918 to 1921. Group A had a very constant decline in accident frequency, totalling 65 per cent. Accident severity declined 60 per cent from 1918 to 1920, and then rose sharply. This rise, however, must be discounted somewhat in view of the very small exposure in 1921. Group B had a much larger exposure and the data is for six months of 1921. The accident frequency rate is very near to that of Group A for the same year; the severity rate is much lower.

TABLE 64.—NUMBER OF FULL-YEAR WORKERS, NUMBER OF ACCIDENTS, AND ACCIDENT FREQUENCY AND SEVERITY RATES, IN THE MANUFACTURE OF RUBBER TIRES, BY YEARS, 1918 TO 1921, AND JANUARY TO JUNE, 1921.

Year.	Hours of exposure (thousands).	Equivalent full-year workers.	Number of accidents.	Frequency rates (per 1,000,000 hours' exposure).	Severity rates (per 1,000 hours' exposure).
Group A: ¹					
1918.....	4,008	1,336	307	76.7	2.6
1919.....	4,725	1,575	302	64.2	2.4
1920.....	4,461	1,487	181	41.1	1.0
1921.....	1,430	477	38	27.1	3.5
Group B: ² January to June, 1921.....	35,592	11,897	887	24.8	.7

¹ National Safety News, April, 1922, p. 34.

² *Idem*, May, 1922, p. 18.

TOOL MANUFACTURE.

The accident data in Table 65 for a tool-making establishment present a very unusual instance of regular and continuous decline of both accident frequency and severity. From 1916 to 1920 there was a substantial reduction, year by year, in both rates. The total decline from 1916 to 1920 was 77 per cent in frequency and 83 per cent in severity. This undoubtedly represents a constant and efficient effort at accident reduction.

TABLE 65.—NUMBER OF FULL-YEAR WORKERS, NUMBER OF ACCIDENTS, AND ACCIDENT FREQUENCY AND SEVERITY RATES IN A TOOL-MAKING PLANT, 1916 TO 1920. ¹

Year.	Hours of exposure (thousands).	Equivalent full-year workers.	Number of accidents.	Frequency rates (per 1,000,000 hours' exposure).	Severity rates (per 1,000 hours' exposure).
1916.....	7,850	2,617	300	38.2	0.70
1917.....	8,190	2,730	148	18.0	.35
1918.....	7,367	2,456	93	12.6	.22
1919.....	7,200	2,400	74	10.3	.15
1920.....	8,210	2,737	71	8.8	.12

¹ National Safety News, Feb. 23, 1921, p. 12.

WOODWORKING AND LOGGING.

In Table 66 are given rates for woodworking additional to those shown in Table 52, and figures for logging companies supplementing those given on page 25. It is evident that logging operations present

extra hazards which for various reasons are difficult to overcome. It is greatly to be hoped that the wide adoption of the recently formulated safety code for logging and sawmill operations will lead to a favorable change.

TABLE 66.—NUMBER OF FULL-YEAR WORKERS, NUMBER OF ACCIDENTS, AND ACCIDENT FREQUENCY AND SEVERITY RATES IN WOODWORKING AND LOGGING, 1920 AND 1921.¹

Item.	Hours of exposure (thousands).	Equivalent full-year workers.	Number of accidents.	Frequency rates (per 1,000,000 hours' exposure).	Severity rates (per 1,000 hours' exposure).
1920					
Woodworking.....	9,129	3,043	322	35.0	3.11
Logging.....	5,238	1,746	294	56.0	6.83
1921					
Woodworking.....	49,792	16,597	2,660	53.5	1.22
Logging.....	2,331	777	191	83.0	6.68

¹ National Safety News, September, 1921, p. 12; July, 1922, p. 31.

CONCLUSION.

It is desirable in concluding this report to emphasize again some points made in the course of it:

1. The report distinctly disclaims completeness. It simply assembles the existing records, pointing out, when necessary, where and why they are deficient.

2. The chief value of the report lies in the fact that it contains a larger body of information regarding the severity rates of different industries and departments of industry than it has been possible hitherto to assemble. The severity rate is a direct and fairly accurate index of hazard. It is preferable to other methods of indicating hazard in that its elements are more stable and uniform than others which might be chosen, such as, for example, pay-roll and compensation costs.

3. The section of the bulletin devoted to State accident data reduces to somewhat comparable form the facts recorded in the various State reports regarding accidents by industries, cause of injury, nature of injury, and location of injury. This has not been possible hitherto.

4. The Federal agencies which compile accident data, namely, the Interstate Commerce Commission, the Bureau of Mines, and the Bureau of Labor Statistics, have steadily improved their procedure until it may fairly be said that the data which they assemble are as complete and accurate as can reasonably be expected and afford a clear idea of the extent of the accident problem in the industries covered and of the trend from year to year.

