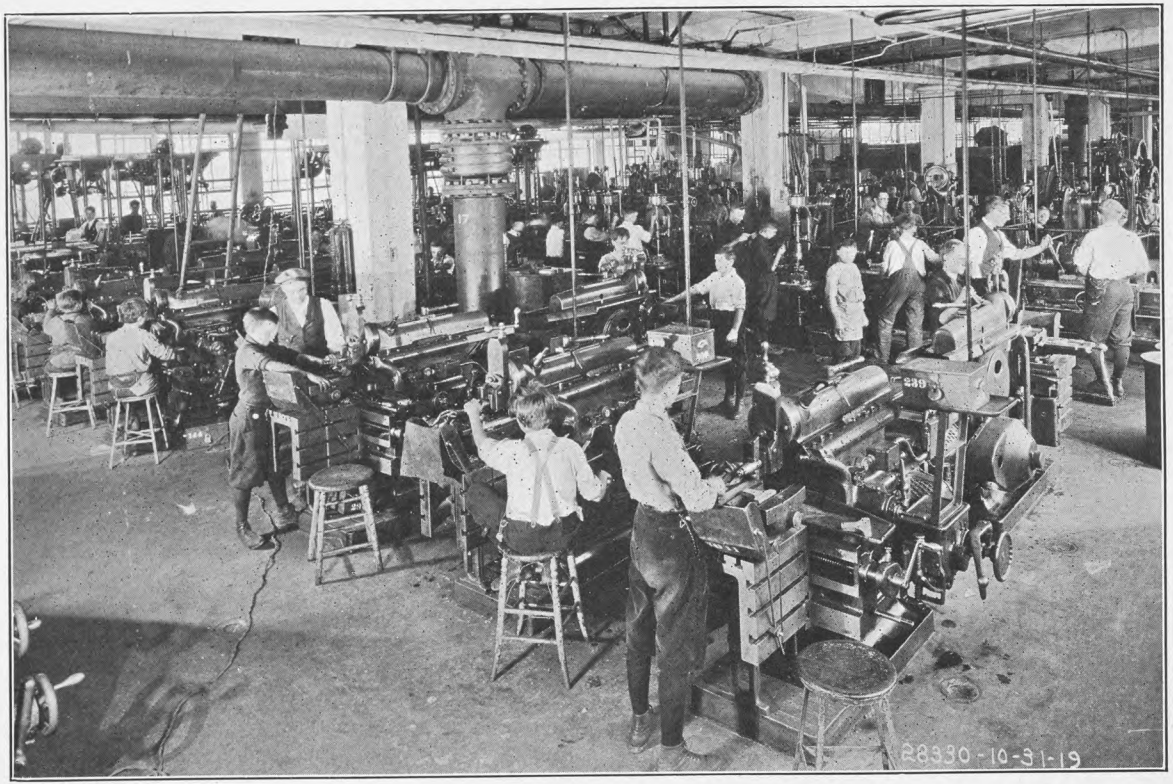

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PLATE I.—TRADE-SCHOOL SHOP. SHAPERS IN FOREGROUND.

U. S. DEPARTMENT OF LABOR
JAMES J. DAVIS, Secretary
CHILDREN'S BUREAU
GRACE ABBOTT, Chief

MINORS IN AUTOMOBILE AND METAL-MANUFACTURING INDUSTRIES IN MICHIGAN

Bureau Publication No. 126

WASHINGTON
GOVERNMENT PRINTING OFFICE
1923

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ILLUSTRATIONS.

LETTER OF TRANSMITTAL.

U. S. Department of Labor,
Children's Bureau,
Washington, June 25, 1923.

Sir: There is transmitted herewith a report on Minors in Automobile and Metal-Manufacturing Industries in Michigan.

This report was prepared in the industrial division of the Children's Bureau. With the exception of securing the records of industrial accidents, which was done under the direction of Walter M. Hinckle, the field work in connection with this study was supervised by Helen M. Dart, who, together with Ella Arvilla Merritt, has written the report. The occupational descriptions were prepared by E. J. Allett, head of the industrial department of the high school in Lansing, Mich.

In the course of the investigation and the writing of the report the Children's Bureau had the cooperation of State and local school officials and officials of the State industrial accident board and the State department of labor, and of automobile and metal manufacturers, all of whom were most generous in granting access to their records and in furnishing information.

Respectfully submitted.

Grace Abbott, *Chief.*

Hon. James J. Davis,
Secretary of Labor.

MINORS IN AUTOMOBILE AND METAL-MANUFACTURING INDUSTRIES IN MICHIGAN.

INTRODUCTION.

PURPOSE AND SCOPE OF STUDY.

This study was undertaken primarily as an evaluation of the status of minor wage earners in certain important manufacturing industries which, because they demand the services of a relatively high proportion of skilled and semiskilled employees, might be thought to offer somewhat exceptional opportunities to their young workers. The purpose of the inquiry was to determine: (1) The standards of the selected industries in regard to the qualifications of the minors entering them; (2) the burden laid by the industry upon its young employees—i. e., the physical demands and hazards of the work performed, and the hours of labor required; and (3) the returns given by the industry to its minor workers in respect to wages, industrial training, and opportunities for advancement. In addition, a brief inquiry was made with respect to the opportunities for vocational training in the city where these industries were located, with especial reference to those offered to employed minors.

In 1919 the manufacture of automobiles, including bodies and parts, ranked seventh in the United States in regard to the average number of wage earners employed and second in regard to value of product. The average number of wage earners employed increased 170 per cent between 1914 and 1919. Although the manufacture of foundry and machine-shop products did not show so rapid a growth, in 1919 it ranked second in the United States in respect to average number of wage earners employed, fourth in respect to value of product.[1]

Since only a limited field could be covered, the study was confined to representative metal-manufacturing[2] establishments in Michigan—a State which is an important center for the manufacture of foundry and machine-shop products, and which leads in the production of automobiles.[3] In 1914, Michigan factories employed slightly over one-half[4] of all the wage earners in the automobile factories of the

[1] U. S. Bureau of the Census, abstract of the Census of Manufactures, 1919, pp. 19 and 230.
[2] Including car shops and the manufacture of automobiles and automobile parts.
[3] Statistics of production of automobiles include the figures for automobile parts.
[4] U. S. Bureau of the Census, Census of Manufactures, 1914, Vol. II, p. 733.

country, in 1919,[5] about one-half. Moreover, in 1914 one-fourth [6] and in 1919 [7] three-eighths of all the wage earners in the State were employed in the manufacture of automobiles and of automobile bodies and parts.

Twenty establishments were included in the survey;[8] 11 of these plants were located in Detroit, 5 in Lansing, 2 in Bay City, 1 in Flint, and 1 in Saginaw. In the 18 plants for which it was possible to secure the number of adult and minor workers, an aggregate of 26,192 wage earners, of whom 11 per cent were under 21 years of age, were employed in the factory proper. The automobile factories included three large plants producing a finished car, two automobile-body factories, and three factories the main output of which was automobile parts. To secure information with regard to the manufacture of foundry and machine-shop products, factories were visited which produced iron and steel castings, gasoline engines, boilers, cranes, ventilating apparatus, bolts, drills, and similar products. The other plants surveyed included a car-repair shop, as well as factories producing forgings, brass and copper sheet metal, wire and tubing, and small brass parts.

The survey was made in the spring of 1920, before the beginning of the period of business depression. All branches of metal manufacture had benefitted to a greater or less degree from the impetus given by the war to the manufacture of munitions, ships, airplanes, and other military supplies. Having returned to a peace-time basis, the factories were doing their best to meet the accumulated demand for automobiles and other metal products for domestic use, the manufacture of which had been curtailed during the war period. Wages were high and work plentiful.

METHOD OF STUDY.

Information was obtained chiefly from the following sources: (1) Pay-roll and employment-office records; (2) interviews with factory officials; (3) observation of factory processes; (4) questionnaires obtained from minor employees; (5) interviews with superintendents and principals of schools giving technical training, and the records of such schools; and (6) State accident records.

Records of age, sex, and occupation of all employees were secured from the employment offices, and these were supplemented by pay-roll data on hours and earnings for all workers under 21. From employment managers was secured special information about each occupation at which minors were found working; e. g., education

[5] Fourteenth Census of the United States, 1920, Vol. X, Manufactures, p. 869.
[6] U. S. Bureau of the Census, Census of Manufactures, 1914, Vol. I, p. 668.
[7] Fourteenth Census of the United States, 1920, Vol. IX, Manufactures, p. 694.
[8] In addition, general data were obtained from one other establishment, an automobile factory.

and experience necessary for employment, method and period of training in the shop, the line of promotion, and the hazards of the work.[9] Typical occupations in which minors were commonly employed were observed and analyzed by a mechanical engineer familiar with the construction and operation of machines and with the technical work of metal manufacturing.

By means of a printed questionnaire[10] each minor was asked for data in regard to his nativity, education and industrial training, and industrial history. These questionnaires were filled out and returned by 913 minors, about one-third of the whole number found employed. Since the more intelligent of the workers were the more likely to be interested and able to fill out the somewhat detailed form, it is not surprising that a slightly larger proportion of this group than of all the minor workers were employed at the more skilled and better-paid types of work. Moreover, returns from foreign-born and negro minors were incomplete, because such workers, through lack of education, often had difficulty in writing out the answers to the questions. While these differences must be borne in mind in interpreting results, they do not seem sufficient to invalidate the very general conclusions indicated by the data secured.

The vocational and technical schools in the cities where the survey was carried on were visited to ascertain what courses were offered on subjects related to work in the metal trades, and what types of pupils were enrolled in such courses. Special emphasis was placed on public-school facilities.

In view of the danger incident to many of the occupations in metal manufacturing, records of the State industrial accident board were studied and a survey was made of safety conditions and accident prevention in the factories included in the inquiry.

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[9] See Appendix II, Form 1.

[10] See Appendix II, Form 2.

MINOR WORKERS IN THE FACTORIES SURVEYED.

PROPORTION OF MINOR EMPLOYEES.

The proportion of minors to the total number of employees in the establishments visited varied but slightly from one city to another. In Detroit 11 per cent of all the workers were under 21 years of age, in Lansing, 12 per cent; and in the three other cities combined, 9 per cent.[11]

Although the percentage of minor employees in the cities studied was fairly constant, considerable variation, due to differences in policy or in the demands of the work, was found in different types of establishments and in individual plants. In one automobile factory, which made it a policy to engage few workers under 18 and to require proof of age for all those under 21, only 9 per cent of the employees were minors; in another, which had a thoroughly worked-out apprenticeship system, 12 per cent were minors. The factories producing automobile bodies and automobile parts such as frames, wheels, bearings, and axles—all of which required the use of heavy machinery—showed 9 per cent of minor employees on the pay roll.

Factories manufacturing foundry and machine-shop products showed an average of 12 per cent, but wide variations existed between the different establishments in the group. In one foundry, for instance, 3 per cent of the workers were minors; in another, 8 per cent; in a factory producing gas engines, 19 per cent; and in one manufacturing drills, 24 per cent. Among the other plants visited, one which produced small brass castings and parts showed 19 per cent of the employees to be minors, while in the car shops only 2 per cent were minors—the lowest per cent in any industry.[12]

As would be expected, minors were found in comparatively large proportions in semiskilled or relatively unskilled occupations.[13] They constituted 32 per cent of the apprentices, 27 per cent of the stock and tool-crib workers, 22 per cent of the laborers and helpers in the foundry and core room, 18 per cent of the truckers and drivers, 18 per cent of the trimmers, 17 per cent of the core makers, and 15 per cent of the inspectors. The lowest proportion, 5 per cent, was found among the skilled workers, such as machinists, sheet-metal workers, molders, pattern makers, and toolmakers.

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[11] The higher proportion of minors in Lansing factories was probably due to the fact that the schools supplement their industrial training by part-time factory work (see p. 46) and to the fact that two of the large factories there employed boys as apprentices.

[12] See General Table I for figures for the various industry groups.

[13] See General Table I, p. 105.

AGE AND OCCUPATION.

Among the employees under 21 years of age the proportion of very young workers was low. As is shown by Table 1, less than 1 per cent of the total number of minors employed were under 16 years of age, while about two-thirds were between 19 and 21. Fifteen of the 19 employers reporting the age at which minors entered their employ said that for most of the occupations in their plants no minors under 17 were employed and most of them reported that for many specific occupations they did not hire minors under 18, either because younger workers had not had time to acquire the experience and skill necessary, or because they did not have sufficiently mature judgment, or because they lacked the requisite physical development. For heavy work such as that of molders, blacksmiths, millwrights, welders' helpers, engine assemblers, stock handlers, and foundry laborers, the general tendency was to employ older workers because of their greater strength and endurance. For a few other occupations, particularly those requiring the use of machinery, some employers stated that workers under 17 or even under 18 had not developed sufficient muscular coordination.

TABLE 1.—*Age, by sex; minors in metal-manufacturing industries.*

Age.	Minors in metal-manufacturing industries.					
	Total.		Boys.		Girls.	
	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.
Total	2,840	100.0	2,536	100.0	304	100.0
14 years, under 15	5	.2	5	.2	.....	.....
15 years, under 16	20	.7	19	.7	1	.3
16 years, under 17	114	4.0	108	4.3	6	2.0
17 years, under 18	198	7.0	171	6.7	27	8.9
18 years, under 19	663	23.3	562	22.2	101	33.2
19 years, under 20	903	31.8	809	31.9	94	30.9
20 years, under 21	935	32.9	860	33.9	75	24.7
Not reported	2	.1	2	.1	.....	.....

Nevertheless, children under 18 years of age were found [14] in all kinds of work in which minors were employed at all. The proportion of apprentices among all employed minors varied from 19 per cent of the 16-year-old workers to 5 per cent of those 20 years of age. A similar tendency, though not so marked, was evident for stock and tool-crib workers. On the other hand, the proportion of machine operators varied from only 13 per cent of the 16-year-old group to 25 per cent of those 20 years of age.

While the nature of the work in the industries studied tended to keep at a low figure the number of employed children under 16 and

[14] See General Table II, p. 106.

even under 18 years of age, the legal provisions in Michigan relating to the employment of children also contributed to this result.

The State law fixed a minimum age of 15 years for full-time employment in factories during the school term and placed such additional restrictions [15] upon children 15 years of age as, if strictly enforced, would keep all but a very small proportion from leaving school for work before they were 16.[16] Even at 16 years of age children were still subject to the "dangerous occupations" law,[17] which forbade the employment of boys under 18 and girls under 21 in "cleaning machinery in motion" and in "any hazardous employment," and gave to the State department of labor the authority to determine what occupations should be considered hazardous.

The Federal child labor tax law,[18] by imposing a tax of 10 per cent upon the yearly profits of any factory employing children under 14, placed a practically prohibitive penalty upon employment of children under that age, and the provisions of the workman's compensation law, more fully discussed in the section on accidents,[19] had indirectly a decided tendency toward forcing a strict compliance with the minimum age provision of the State child labor law.

SEX.

Comparatively few women were employed in the factories visited. In the establishments for which information regarding the sex of adult workers could be secured from the pay rolls, as shown in Table 2, only 521, or about 3 per cent of the 15,807 employees, were females.[20] Of all those under 21 employed in these establishments, however, 9 per cent were girls, and in the entire group of 521 women workers 141, or 27 per cent, were under 21 years of age. Evidently, therefore, the proportion of females among workers 21 years of age and over was very small. Table 1 indicates that the decrease with

[15] An employment certificate was necessary for work for each new employer, and was issued only upon satisfaction of the following requirements: (1) Promise of employment; (2) proof of age; (3) completion of sixth grade; (4) ability to read intelligently and to write simple English sentences; (5) statement by issuing officer that in his opinion child was of normal development, in sound health, and physically able to perform intended work, such physical fitness, in doubtful cases, to be determined by a medical officer of the board or department of health; (6) services necessary to support of his parents or himself. (Howell's Annotated Statutes, sec. 4018 as amended by acts of 1917, No. 280.) The last clause in particular made it possible to reduce considerably the number of children receiving permits.

[16] Children 14 years of age were permitted to work in factories during school vacation and outside school hours upon satisfying all the requirements for a full-time certificate except those relating to education and necessity of services.

[17] More fully discussed in connection with industrial accidents, p. 48.

[18] 40 Stat. L. 1138 (Revenue Act of 1918, approved Feb. 24, 1919, Title XII). This law was declared unconstitutional by the U. S. Supreme Court on May 15, 1922.

[19] See p. 48.

[20] In the iron and steel manufacturing industries the proportion of women wage earners has always been very small. In 1914 they constituted only 2 per cent of the workers 16 years of age in automobile factories and only 3 per cent in the foundries and machine shops in Michigan. During the war there was an increase in the number of women at work in these and allied industries. In 1919 in Michigan the per cent of women among wage earners 16 years of age was 4 per cent in automobile factories, 5 per cent in the manufacture of automobile bodies and parts, and 6 per cent in the manufacture of foundry and machine-shop products. Fourteenth Census of the United States, 1920, Vol. IX, Manufactures, p. 673.

age in the proportion of female workers began even before 21 years. A larger percentage of girls (33 per cent) was found in the age group 18 years of age than in any other, the number in the two succeeding years decreasing to 31 and 25 per cent, respectively. The number of boys, on the other hand, increased steadily from 18 to 21 years of age.

TABLE 2.—*Sex, by industry; adult and minor employees in metal-manufacturing industries.*

Industry.	Employees in metal-manufacturing industries.											
	Total.				Adult.				Minors.			
	Total.	Male.	Female.		Total.	Male.	Female.		Total.	Male.	Female.	
			Number.	Per cent.			Number.	Per cent.			Number.	Per cent.
Total [1]	15,807	15,286	521	3.3	14,288	13,908	380	2.7	1,519	1,378	141	9.3
Automobiles	9,020	8,523	497	5.5	8,104	7,742	362	4.5	916	781	135	14.7
Automobile bodies and parts	3,829	3,828	1	(2)	3,481	3,481	.....	.....	348	347	1	0.3
Foundry and machine shop	2,654	2,649	5	0.2	2,420	2,420	.....	.....	234	229	5	2.1
Other	304	286	18	5.9	283	265	18	6.4	21	21	.....	.....

[1] In factories employing 10,385 persons, sex for adult workers could not be secured from office records.
[2] Less than one-tenth of 1 per cent.

Girls were employed in a much more limited group of occupations than boys, as may be seen by reference to Table 7,[21] which shows the occupations in which minors of either sex were engaged. Foundry and most machine-shop work was generally considered by employers too heavy and dirty for women, and women themselves, possibly for the same reason, did not appear to seek it. The occupations in which girls were most commonly employed were inspection, trimming, assembling of small parts, sewing-machine operating, stock and tool-crib work, core making, and thread-machine operating—in the order named.[22] Some of these occupations—particularly sewing-machine operating and trimming, in which 23 per cent of the girls and less than 3 per cent of the boys were employed—are not, strictly speaking, metal-manufacturing occupations at all, but constitute such an integral part of automobile manufacturing that they should not be omitted in a study including that industry. This fact accounts in large part for the relatively high proportion of girls in the automobile factories, as shown in Table 2.

Eight of the twenty employers interviewed stated that it was contrary to their policy to employ women in factory work because the work was heavy and women lacked the necessary technical qualifications. Two firms that had taken on women during the war period had replaced them with men at the end of the war. This policy may have

[21] P. 15.
[22] For description of the work of core makers, thread-machine operators, and inspectors see pp. 70, 83, and 90, respectively.

been due partly to the reluctance of employers, when it was possible to secure men and boys, to face the new problems of factory management and equipment which the employment of women would involve. This reluctance may have been increased by the restrictions placed by law upon the employment of women, limiting their hours of work, requiring special safeguards and sanitary equipment in factories where they were employed, and excluding them from certain dangerous or harmful occupations.[23]

NATIVITY AND FATHER'S NATIONALITY.

According to Table 3, about half of all the minors reporting nationality were either themselves foreign born or of foreign parentage. Of this entire group,[24] more workers (20 per cent of the whole number) named Canada as the father's birthplace than any other country, and almost as many (15 per cent) reported fathers born in the United Kingdom. Nearly all the rest reported fathers belonging to non-English speaking European nationalities. Among the minors who were themselves foreign born (about two-fifths of the group who were foreign born or had foreign-born fathers), 38 per cent had fathers born in the United Kingdom or in Canada, 13 per cent in Austria-Hungary, 8 per cent in Poland, and 6 per cent in Germany.

The percentage of girls, according to Table 3, was lowest among native children of native fathers—9 per cent; it rose to 16 per cent for the foreign-born children, and was highest—20 per cent—among native children of foreign-born fathers. But nativity appeared to have little relation to the age or the occupation of the minors at work.

TABLE 3.—*Nativity of father and color and nativity of child, by sex of child; minors in metal-manufacturing industries.*[1]

Nativity of father and color and nativity of child.	Minors in metal-manufacturing industries.[1]				
	Total.	Boys.		Girls.	
		Number.	Per cent.	Number.	Per cent.
Total	[2] 589	510	86.6	79	13.4
White	568	489	86.1	79	13.9
Native	448	388	86.6	60	13.4
Father native	270	245	90.7	25	9.3
Father foreign born	172	138	80.2	34	19.8
Nativity of father not reported	6	5	.....	1	.....
Foreign born	120	101	84.2	19	15.8
Negro	21	21	.....	.....	.....

[1] Questionnaire group. [2] Information as to color and nativity not secured for 324 minors.

Although only 6 of the employers interviewed stated that they did not employ negro labor, only 21 minors—4 per cent of the whole number for whom information as to race was obtained—were negroes. All were boys over 18 years of age, and 14 were laborers or helpers.

[23] Michigan, acts of 1909, No. 285, secs. 9 (as amended by acts of 1919, No. 341), 11 (as amended by acts of 1915, No. 255), 14 (as amended by acts of 1913, No. 160), 17 (as amended by acts of 1915, No. 3), and 24.

[24] See General Table III.

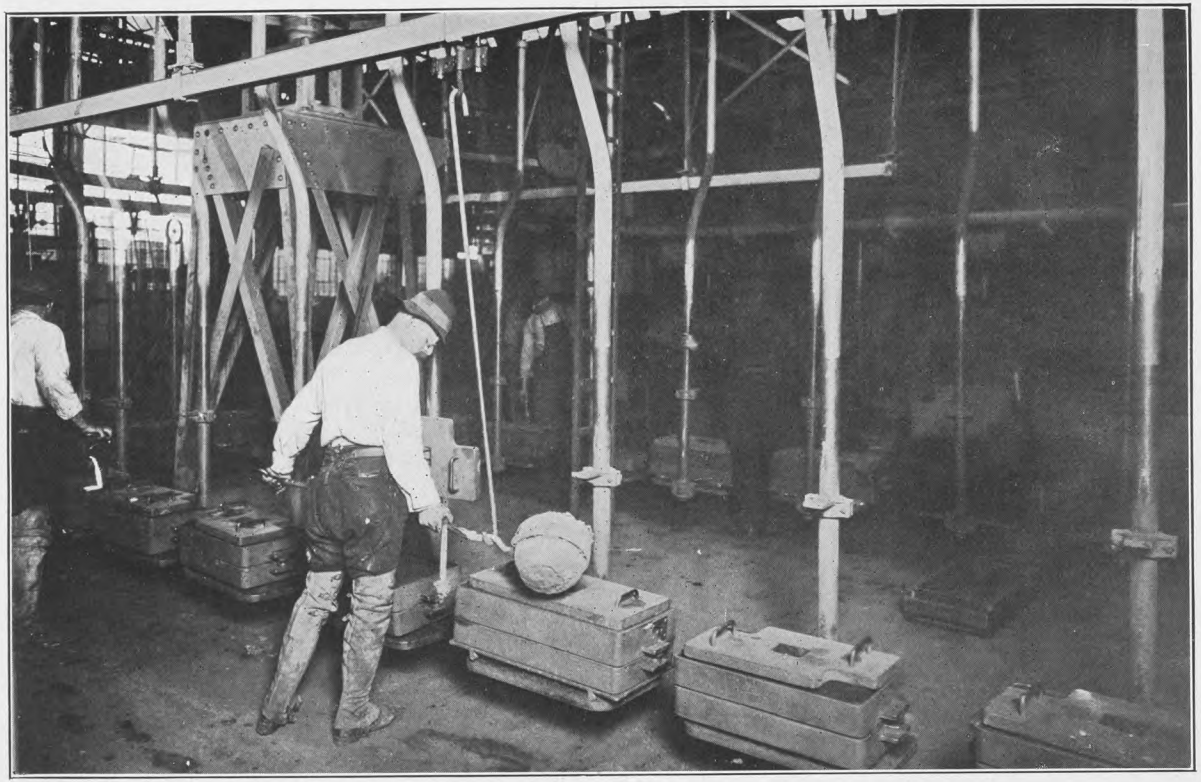

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PLATE II.—FOUNDRY. POURING WITH HAND LADLES.

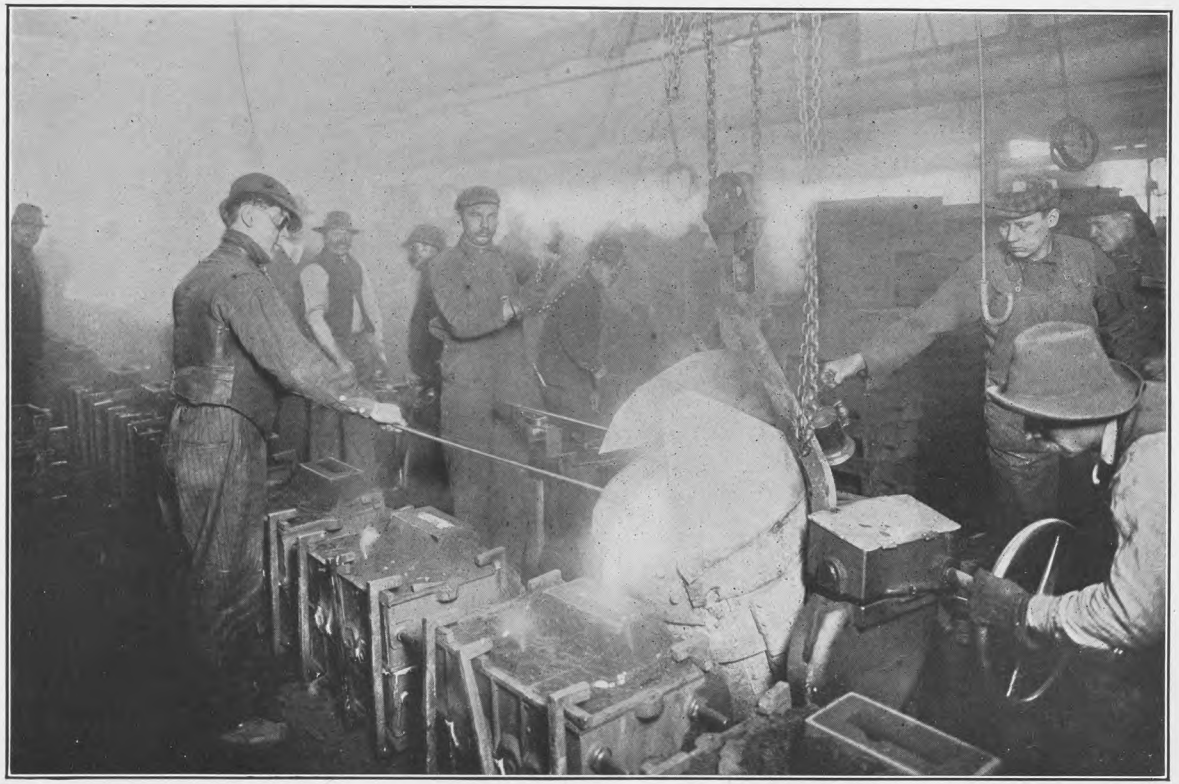

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PLATE III.—FOUNDRY. POURING MOLTEN IRON INTO MOLDS. LADLE TILTED BY HANDWHEEL.

HOURS OF LABOR.

Hours worked.

Thirteen of the 18 employers from whom information concerning hours of labor was secured reported 9 hours as the regular working day in most of their production departments. In 8 of these 13 factories the regular working week was 50 hours; in 2, 49½ hours; in 1, 50½ hours; and in 2, 54 hours. Four establishments had a 48-hour week, 1 with an 8-hour day, 1 with an 8½, and 2 with an 8¾-hour day. A working day of 10 hours with a week of 54 hours was reported by 1 factory.

Over three-fifths (62 per cent) of all the minors in these 18 establishments were working in factories which had a 9-hour day and a 49½ to 50½ hour week schedule; and 95 per cent were employed in factories where the working week was between 48 and 51 hours. Nevertheless the pay-roll figures for the hours actually worked by the minors employed show that only a small proportion of them had worked between 48 and 51 hours during the week for which data were secured.[25] Eliminating the employed minors whose names did not appear on the pay rolls from which information as to hours was secured,[26] as is done in Table 4, it is found that about three-fifths of those whose hours were reported had worked fewer hours than 48, and that more than one-fifth had worked less than 36 hours. On the other hand, 16 per cent had worked 54 hours or more; and 157, or 7 per cent, had had a working week of 60 hours or longer.

TABLE 4.—*Number of hours worked per week, by sex; minors on pay roll in metal-manufacturing industries.*

Number of hours worked per week.	Minors on pay roll in metal-manufacturing industries.					
	Total.		Boys.		Girls.	
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Total	[a] 2,212	100.0	1,957	100.0	255	100.0
Less than 36 hours	478	21.6	423	21.6	55	21.6
36 hours and over	1,734	78.4	1,534	78.4	200	78.4
42 hours and over	1,449	65.5	1,290	85.9	159	62.4
48 hours and over	858	38.8	785	40.1	73	28.6
54 hours and over	351	15.9	332	17.0	19	7.5
60 hours and over	157	7.1	155	7.9	2	0.8

[a] Excludes 619 minors (572 boys and 47 girls) whose names did not appear on pay roll from which information as to hours was secured and 9 minors (7 boys and 2 girls) for whom number of hours per week was not reported.

[25] See General Table IV. All the tables relating to hours of labor give the number of hours actually worked by minors as shown by the pay rolls. To secure a common basis for comparison, all pay rolls which were made upon a biweekly or semimonthly basis were reduced to a weekly basis. The figures based on the longer periods were less liable to be affected by chance variations than those taken from pay rolls made up weekly. (See p. 12, footnote 39).

[26] It was necessary, for convenience in working, that the information as to hours be taken from the pay roll previous to the current one; or, in case this did not show normal conditions, the most recent one representing a period when conditions were normal. Names of children employed, on the other hand, to be used in obtaining questionnaires, were taken from the current employment-office records. Thus the names of workers hired subsequently to the date of the selected pay roll would appear on the employment-office records, but not on the pay roll used.

The scope of the inquiry did not permit securing positive information in explanation of the short working week which was shown for so large a proportion of the minor employees. It is true that the railway switchmen's strike, which occurred during the survey, necessitated for a time a complete or partial shutdown of nearly all factories, but the pay-roll periods selected were not affected by this disturbance. At the time of the study employers were trying to increase rather than to curtail production. In some cases the short hours worked were doubtless due to sickness. Accidents or other causes necessitating shutdowns in certain departments may account for a small proportion. Also, the fact that wages were high and work easy to secure may have induced a certain amount of absenteeism. But it is probable that a high percentage of the short-hour weeks was due to shifting from one job to another. This is indicated by the fact that the number of minors employed whose names were not found on the pay roll previous to the current one amounted to 22 per cent of the whole.[27] Likewise, a large proportion of the questionnaires sent to minors whose names appeared on the employment-office records were returned blank because during the short period while the records were being copied and the questionnaires prepared for distribution these boys and girls had left their jobs.

Among the minors whose hours were reported, exactly the same proportion of boys as of girls, 78 per cent, worked 36 hours or more; but Table 4 shows a somewhat larger percentage of boys than of girls in each of the groups where the working hours were 42 or over per week. Eight per cent of the boys and only 2 girls—less than 1 per cent—had worked 60 hours or longer. No significant variation is seen in the number of hours worked by minors of different ages.[28] Somewhat greater differences appear, however, when the occupations in which minors were engaged are considered. In general the hours of assemblers averaged 41.2, an average somewhat shorter than that for workers in any other occupation, while the hours of laborers and helpers averaged longest, 47.3.[29] Among those working 60 hours or more there was a larger proportion of laborers and helpers than of any other group, with stock and tool-room workers, inspectors, and machine operators, following in the order named, and assemblers having the smallest proportion. Another indication of the types of work in which the longest hours prevailed is seen in the fact that the occupation groups showing the largest percentages of minors who had worked on the average over 54 hours per week during the pay-roll period were stock and tool-room workers, laborers and helpers,

[27] See p. 9, footnote 26, and Table 4, footnote a.
[28] See General Table IV.
[29] Figures in this sentence are based on the questionnaire group.

and inspectors (in that order), while the occupation showing the smallest percentage was again that of assembler.

Pieceworkers as a rule worked longer hours than those paid on a time-rate basis.[30] Among the minors from whom questionnaires were received 26 per cent of those paid piece rates and only 14 per cent of those paid time rates worked more than 54 hours, whereas but 12 per cent of the pieceworkers and 21 per cent of the time workers were in the group working what might be called "normal" hours; i. e., 48 to 51 hours per week.

As already noted,[31] the names of 22 per cent of the minors at work in the factories included in the survey were not found on the pay rolls referred to, and therefore no hours were secured for them. The proportion of these cases was higher for minors under 17 than for those in any other age group, and was somewhat higher among boys than among girls.[32] When occupations are considered, it was lowest for assemblers and highest for laborers and helpers. This indicates, probably, greater turnover among the boys and among the younger and less skilled workers.

Few statistics are available which might be used to compare the hours worked by minors in the factories included in the survey with hours worked either by minors or by all employees in similar plants throughout the country. A survey made by the United States Bureau of Labor Statistics in 1919 showed the average hours actually worked per week in the automobile industry as 49.2 for all male and 46.8 for all female employees, somewhat longer than the average hours worked (44.8) by the minors included in the questionnaire study. Among the men the shortest hours were those of assemblers (as in this study); of the workers classed as "chippers, grinders, sand-blasters, tumblers, and cleaners";[33] of cushion makers and cutters (trim shop); and of top builders and back hangers. The longest hours among the men were those of hardeners and furnace tenders and of machine setters. Among the women, assemblers, drill-press operators, and lathe operators worked the shortest hours and bench hands in the machine shop the longest.[34]

Legal limitations on hours.

The Michigan law limited the weekly hours of work of all women and of boys under 18 in manufacturing establishments to 54.[35] Hours for both girls and boys under 16 were further affected by the Federal child labor law, which placed a tax of 10 per cent upon the yearly

[30] See General Table V.

[31] See p. 10.

[32] See General Table IV.

[33] Corresponding to foundry and core-room laborers in the classification here used.

[34] Wages and hours in automobile, car, electrical-apparatus, foundry, machinery, machine-tool, and typewriter industries. U. S. Department of Labor, Monthly Labor Review, June, 1920, pp. 82-94.

[35] Howell's Annotated Statutes, 1913, sec. 4017, as amended by acts of 1919, No. 341.

net profits of any factory employing children of that age more than 48 hours a week.[36] Forty-seven minors, 2 per cent of those whose names appeared on the pay rolls and who reported hours had worked a greater number of hours during the week than the standard set by law. One of these was a 15-year-old boy who had worked a 50-hour week. Thirty-two were boys between 16 and 18 (14 per cent of the boys of those ages) who had worked more than 54 hours a week, and 14 were girls (6 per cent of the girls under 21) who had likewise been employed in violation of the 54-hour-week law.

The number of violations of the legal restrictions upon hours per day and upon work at night[37] is not known, because no data were secured for the hours of beginning and stopping work each day.

EARNINGS.

During a period when the effect of war-time scarcity of labor and increased demand for workers was still evidenced in a higher level of wages than had ever been known in this country, it was not surprising to find that in many cases even young persons under 21 years of age were receiving large earnings. Of the 793 minors who answered the questionnaire and reported weekly wages, 44—all boys—had received from $50 to $75 a week, and 5 boys $75 or more.[38] The median weekly earnings for all the minors employed were $27. Twenty-three per cent of those reporting earnings had received $35 or more, and only 17 per cent less than $15.[39] A large proportion of those who were paid less than the median earnings had not worked a full week—83 per cent of the minors who received less than $15 and 46 per cent of those who received less than $25 had worked fewer hours than 36.

Earnings per hour were on a similarly high level. The median hourly wage was 60 cents. About one-third of the minors reporting wages per hour, according to Table 5, received from 50 to 60 cents, one-fourth from 60 to 70 cents, and slightly over one-fourth 70 cents or over.

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[36] 40 Stat. L. 1138 (Revenue Act of 1918, approved Feb. 24, 1919, Title XII). The law in effect limited hours to a maximum of 8 per day for 6 days per week. This law was declared unconstitutional by the U. S. Supreme Court on May 15, 1922.

[37] The State law limited factory hours for women and for boys under 18 to 10 per day, and prohibited such work between 6 p. m. and 6 a. m. to girls under 18 and boys under 16. (Howell's Annotated Statutes, 1913, sec. 4017, as amended by acts of 1919, No. 341.)

[38] See General Table VI.

[39] See General Table VII. Earnings, like hours, were taken from a sample pay roll; and, as in the case of hours, data included information concerning many minors who had not been at work for the entire pay-roll period, and for many of the minor employees information could not be secured at all. See footnote 26, page 9.

TABLE 5.—*Earnings per hour,*[1] *by sex; minors in metal-manufacturing industries.*

Earnings per hour.[1]	Minors in metal-manufacturing industries.					
	Total.		Boys.		Girls.	
	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.
Total	2,840	.....	2,536	.....	304	.....
Total reporting	2,183	100.0	1,937	100.0	246	100.0
20 cents, less than 30	19	.9	18	.9	1	.4
30 cents, less than 40	176	8.1	59	3.0	117	47.6
40 cents, less than 50	201	9.2	138	7.1	63	25.6
50 cents, less than 60	689	31.6	656	33.9	33	13.4
60 cents, less than 70	538	24.6	520	26.8	18	7.3
70 cents, less than 80	230	10.5	217	11.2	13	5.3
80 cents, less than 90	121	5.5	120	6.2	1	.4
90 cents, less than $1.00	110	5.0	110	5.7	.....	.....
$1.00 and over	99	4.5	99	5.1	.....	.....
Not on pay roll and not reported	[2] 657	.....	599	.....	58	.....

[1] Actual hourly earnings, computed by dividing the weekly earnings, including any bonus or overtime pay, by the number of hours worked.

[2] Includes 619 minors whose names did not appear on the pay roll and 38 whose earnings per hour were not reported.

Earnings and hours.

With the high rates of pay prevailing, long hours were often coincident with large weekly earnings.[40] More than four-fifths of those who had worked 60 hours or over had earned $35 or more. Instances were found where high pay had been received only after phenomenally long hours. A 19-year-old electric-truck driver who had worked 101½ hours during the week had received $60; an 18-year-old furnace laborer was paid $72 for 83 hours' work; a body inspector had worked 71 hours for $51. On the other hand, one-fourth of those earning $35 or over had worked only from 42 to 48 hours; and one-tenth, less than 42 hours. One 18-year-old core maker, for instance, had earned $64 in a 45-hour week on a piece-rate basis; a paneler on piecework, in an automobile-body factory, received $59 for a 35-hour week; and a drill-press operator in an automobile factory had earned $65 in a 47-hour week.

Earnings and sex.

Earnings would have averaged still higher had it not been for the lower wages paid to girls as compared with boys. While the median weekly earnings received by boys were approximately $28, those for girls were about $18. It might be thought that this difference is attributable to the longer hours worked by boys than by girls, but the median hourly earnings [41]—62 cents for boys and 41 cents for girls—show that the boys were getting about 50 per cent more per hour than the girls. Nor can the discrepancy be accounted for

[40] See General Table VII.

[41] See Table 7, p. 15.

by the occupations in which girls were engaged; for example, boys received a median wage of 63 cents for core making, and girls but 46 cents; for drill-press operating, boys received 68 cents and girls 53 cents. What proportion of these discrepancies were in violation of the Michigan law [42] requiring equal pay for equal work can not be determined, because neither the relative amount of work done by boys and girls nor the extent to which occupations having the same name actually involved the same kind of work is known.

Earnings and age.

The median weekly earnings increased steadily with each year of age. Beginning with 16 years, the medians for each year were $21.79, $25.71, $27.22, $30.13, and $32.23. For all the workers under 18 the median earnings were $23.52. These earnings are considerably higher than those shown in a report on wages in Ohio manufacturing industries in 1919, which gives as the median wage for workers under 18, $12.22 for boys and $10.92 for girls.[43] While earnings in the metal-manufacturing industries were undoubtedly higher than in factories in general, the difference, when age is considered, is probably not so great as these figures indicate, since the Ohio industries may have included a larger proportion of children under 16 than were found in this survey.[44]

Earnings and length of work histories.

Closely related to the increase of earnings as the worker grows older is the increase, shown in Table 6, coincident in general with years of experience in industry. The median hourly earnings increase from 54 cents for those who had worked less than one year to 60 cents for workers with between one and two years' experience, and rise to a maximum of 73 cents for the group who had had five years' experience. The drop to 69 cents for minors who had work histories of six years and 58 cents for those who had worked for seven years or more, though based upon a comparatively small number of instances, indicates that experience gained by starting to work at 14 years of age or younger may be more than offset, as a factor in earning power, by disadvantages incident to a too early substitution of industrial life for school training. The median weekly earnings, however, were higher for the boys who had worked six years or more than for any other group, showing, in connection with the drop in hourly earnings, that they had worked longer hours. Since no data are available to show what proportion of the working years of these

[42] Michigan, Acts of 1919, No. 239.

[43] Wages in Ohio Manufacturing Industries in 1919; U. S. Department of Labor, Monthly Labor Review, Feb. 1921, p. 85. The median wage is computed on the basis of the wage-earners group.

[44] Figures for Ohio are, nevertheless, probably more comparable with those found in this study than would be true of figures for most other States, since the minimum age for work in manufacturing establishments in Ohio was 15 years for boys and 16 for girls.

children had been spent in metal-working industries, no reliable conclusion can be drawn regarding the extent to which earning capacity was increased by experience in the industry. It is evident, however, that the boy or girl who had been at work for several years was rewarded by a higher wage, largely because of the maturity and industrial experience gained.

TABLE 6.—*Median earnings per hour, by length of work history; minors in metal-manufacturing industries.*[1]

Length of work history.	Minors in metal-manufacturing industries.[1]					
	Total.		Boys.		Girls.	
	Total reporting.	Median earnings per hour.	Total reporting.	Median earnings per hour.	Total reporting.	Median earnings per hour.
		Cents.		*Cents.*		*Cents.*
Total	[2] 791	62.9	702	64.8	89	40.7
Less than 1 year	104	54.4	92	55.6	12	36.0
1 year, less than 2	139	59.7	122	61.7	17	46.3
2 years, less than 3	190	61.8	162	64.1	28	39.3
3 years, less than 4	163	66.9	151	68.2	12	40.0
4 years, less than 5	109	65.9	95	67.6	14	44.0
5 years, less than 6	54	72.5	50	73.6	4	.....
6 years, less than 7	15	69.0	14	70.0	1	.....
7 years and over	9	58.3	8	60.0	1	.....
Not reported	8	.....	8	.....	.....	.....

[1] Questionnaire group. [2] Excludes 122 who did not report earnings per hour.

Earnings and occupation.

As shown by Table 7, the highest median hourly earnings—80 cents an hour or more—were paid to boys working as painters, trimmers, body assemblers, motor, final, and outfit assemblers and sheet-metal workers. Wages averaged lowest for apprentices, oilers, straighteners, stock and tool-crib workers, and laborers and helpers, all of whom received between 50 and 60 cents an hour. Among the girls, the lowest rates were paid to inspectors and assemblers (36 and 38 cents, respectively) and the highest (48 cents) to machine operators.

TABLE 7.—*Earnings and median earnings per hour, by occupation and sex; minors in metal-manufacturing industries.*

Occupation and sex.	Minors in metal-manufacturing industries.									
	Earnings per hour.									Not on pay roll and not reported.
	Total.	Median earnings per hour.	Less than 50 cents.	50 cents, less than 60.	60 cents, less than 70.	70 cents, less than 80.	80 cents, less than 90	90 cents, less than $1.	$1 and over.	
Boys	2,536	$0.62	215	656	520	217	120	110	99	[1] 599
Apprentices	196	.51	75	41	27	13	.....	3	.....	37
Assemblers	196	.79	4	28	21	30	30	19	27	37
Motor, final, and outfit	64	.81	2	3	6	16	9	12	8	8
Body	29	.84	1	1	1	6	7	2	6	5
Other	103	.71	1	24	14	8	14	5	13	24

[1] Includes 572 boys whose names did not appear on pay roll and 27 whose earnings per hour were not reported.

TABLE 7.—*Earnings and median earnings per hour, by occupation and sex; minors in metal-manufacturing industries*—Continued.

Occupation and sex.	Minors in metal-manufacturing industries.									
	Earnings per hour.									Not on pay roll and not reported
	Total.	Median earnings per hour.	Less than 50 cents.	50 cents, less than 60.	60 cents, less than 70.	70 cents, less than 80.	80 cents, less than 90.	90 cents, less than $1.	$1 and over.	
Bench	42	$0.65	3	8	13	2	3	5	2	6
Blacksmiths, forgemen, hammermen and welders	8	.65	.....	2	3	1	1	.....	.....	1
Coremakers	15	.63	2	4	3	1	1	1	2	1
Dippers, sprayers, rubbers, and sanders	10	.65	.....	4	2	.....	.....	1	3	.....
Draftsmen and designers	13	.65	1	2	2	2	1	.....	.....	5
Foremen and superintendents	6	.....	.....	.....	3	1	.....	.....	.....	2
Heaters	14	.60	2	4	3	.....	2	1	.....	2
Heat treat	7	.75	.....	2	.....	1	2	.....	.....	2
Inspectors	227	.64	16	47	86	31	3	3	1	40
Final	14	.58	1	5	2	2	.....	.....	.....	4
Other	213	.64	15	42	84	29	3	3	1	36
Laborers and helpers	580	.59	45	186	137	24	13	9	3	163
Foundry and core room	105	.57	17	39	33	2	.....	1	.....	13
Machine helpers	29	.63	2	6	6	3	2	.....	.....	10
Messengers	14	.50	8	4	.....	.....	.....	.....	.....	2
Truckers	202	.58	88	81	39	6	7	1	.....	60
Other	230	.62	10	56	59	13	4	7	3	78
Machinists	159	.64	3	43	28	18	5	14	3	45
Adjusters	14	.59	.....	7	3	1	.....	1	.....	2
Repairs	97	.66	1	23	18	14	4	6	2	29
Setters	6	.63	1	1	2	1	.....	.....	.....	1
Tester	36	.61	1	11	4	1	1	7	.....	11
Other	6	.....	.....	1	1	1	.....	.....	1	2
Machine operators	542	.66	23	101	121	56	38	28	36	139
Drills	115	.68	2	19	28	11	11	7	10	27
Grinders	98	.67	1	18	29	14	9	4	4	19
Lathes	94	.67	4	17	19	10	5	5	7	27
Milling	81	.61	10	21	19	4	3	7	3	14
Presses	19	.65	1	3	3	2	1	.....	1	8
Screw	29	.67	2	4	9	1	4	2	3	4
Thread	11	.....	.....	.....	.....	.....	.....	1	.....	10
Other	95	.68	3	19	14	14	5	2	8	30
Millwrights	5	.....	.....	1	1	.....	1	.....	.....	2
Molders	6	.65	1	1	2	2	.....	.....	.....	.....
Oilers	15	.55	2	4	2	.....	.....	.....	.....	7
Painters	17	.93	.....	3	1	1	1	4	4	3
Sheet-metal workers	23	.80	.....	1	2	5	4	2	2	7
Stock and tool-crib workers	270	.56	28	121	34	9	1	5	1	71
Counters	32	.58	1	16	8	.....	1	.....	.....	6
Stock chasers	17	.54	3	12	.....	.....	.....	.....	.....	2
Other	221	.56	24	93	26	9	.....	5	1	63
Straighteners	22	.56	2	14	1	.....	3	.....	1	1
Toolmakers	15	.73	.....	4	1	6	1	1	.....	2
Trimmers	60	.87	.....	9	5	5	10	10	12	9
Other	88	.61	8	26	22	9	.....	4	2	17
Girls	304	.41	181	33	18	13	1	.....	.....	[2] 58
Assemblers	35	.38	19	6	2	1	.....	.....	.....	7
Core makers	16	.46	9	.....	4	2	.....	.....	.....	1
Inspectors	83	.36	63	.....	1	.....	.....	.....	.....	19
Machine operators	77	.48	33	18	5	3	1	.....	.....	17
Drills	8	.53	2	4	.....	.....	.....	.....	.....	2
Milling	8	.47	5	2	.....	.....	1	.....	.....	.....
Sewing	26	.49	11	5	4	1	.....	.....	.....	5
Thread	15	.43	7	2	1	.....	.....	.....	.....	5
Other	20	.48	8	5	.....	2	.....	.....	.....	5
Stock and tool-crib workers	18	.41	14	.....	2	.....	.....	.....	.....	2
Trimmers	44	.45	25	7	3	6	.....	.....	.....	3
Other	31	.45	18	2	1	1	.....	.....	.....	9

[2] Includes 47 girls whose names did not appear on pay roll and 11 whose earnings per hour were not reported.

Method of payment.

Methods of payment varied widely in different factories and for different kinds of work. Somewhat over half of all the minors who replied to the questionnaires were paid principally on a time-rate basis, a third were on piecework, and the remainder were not on the pay roll from which figures were secured. Several factories paid bonuses of one kind or another—for instance, one gave a bonus for work turned out in excess of a set standard, and another for night work and for good attendance. Most of the factories paid time and a half for overtime work, but two paid only time and a quarter and five paid only the regular rates. Although most of the factories computed overtime by the day, three paid extra for overtime only if the total hours worked for the week or pay period were in excess of the total regular hours for the factory during that time.

In 12 of the factories visited, employing 53 per cent of the minors included in the survey, the pay-roll period was two weeks or one-half month; in the others the employees were paid by the week.

PROMOTION.

Possible lines of promotion.

More important than the initial wage in an appraisal of factory opportunities is the possibility of advancement, either to a supervisory position, such as that of boss or foreman, or to work of greater skill or variety. In regard to this point as definite information as possible was secured from employment managers in the factories studied, but types of machines and methods of factory organization varied so widely in the different plants that it is difficult to do more than suggest methods by which employees qualified for advancement.

Two or three employers said that for most of their minor workers there were no opportunities for promotion. In most of the factories visited, however, some of the more desirable vacancies were filled by promotion from within the factory and some by bringing in men from outside. One large automobile factory even made it a practice to transfer laborers to production work after they had been in the factory two months. Except for their apprentices, however, employers had worked out no "line of promotion" which definitely assured advancement to skilled or more responsible work; but when a trained man from outside could not conveniently be found to fill a position which demanded skill and experience, in many cases some one within the factory whose work had been such as partially to fit him for it would be given the position. Thus, although no definite system of promotion existed, experience in certain kinds of work often helped to fit the worker for a higher-grade job.

A laborer in the foundry, who wheels sand to the molders, cleans castings, tends the rattlers, or does other odd jobs, will learn by

observation how molds are made, how the hot metal is handled, and what are the danger points of the workroom. The foreman and the skilled workmen come to know him and are able to judge his native ability and his willingness to work. When a molder's helper is needed, this knowledge of production methods gives the foundry laborer an advantage over applicants from outside the factory who have not had experience as molder's helpers in other foundries. In the same way, but more definitely, the molder's helper gains experience in his work which fits him to become a molder.

In the machine shop the laborer, who cleans up around the machines, the trucker, who keeps the operators supplied with stock and takes the finished product from one machine to the next and then to the stock room, and the oiler, who works near the machines constantly, will see how machines are controlled and how the finished stock should look. They will learn the common shop terms and as they become accustomed to working near machinery they will be less liable to injury from it. When no experienced men apply for vacancies, the foreman is likely to select the most promising of these machine-shop laborers as operator on one of the simpler machines, such as the drill press, the threading or tapping machine, or the rough grinder. The worker thus becomes familiar with the method of power transmission, which seldom varies from one machine to another in the same factory. This experience, together with a knowledge of how to control a simple machine and to produce work with accuracy and speed, is a help in learning more difficult work or in operating a more complicated machine, such as the lathe, the boring mill, or the tool grinder. Mastery of several types of machine operation helps to fit the operator for the work of adjusting machines to different types of work.

Boys who happen to be selected for work as tool grinders become familiar not only with machine operation but also with the names and uses of various kinds of tools. This helps to fit them for work as toolmakers, and experience as toolmaker is considered practically indispensable to tool designers. Familiarity with the tools used in the shop, which is gained by the tool-room and tool-crib clerks and by laborers in handling the tools or carrying them to parts of the factory where they are needed, is an asset for a tool grinder or tool-lathe operator.

An inspector must be able to judge whether the particular piece of work which he is inspecting is up to the standard set. Where the work to be judged is very simple, as in the case of inspecting small sheet-metal parts,[45] workers with no previous factory experience may do it. Where, on the other hand, inspection comes as the last step in the production of a complex machine, it demands a worker who is familiar with the whole production process. For

[45] See p. 90.

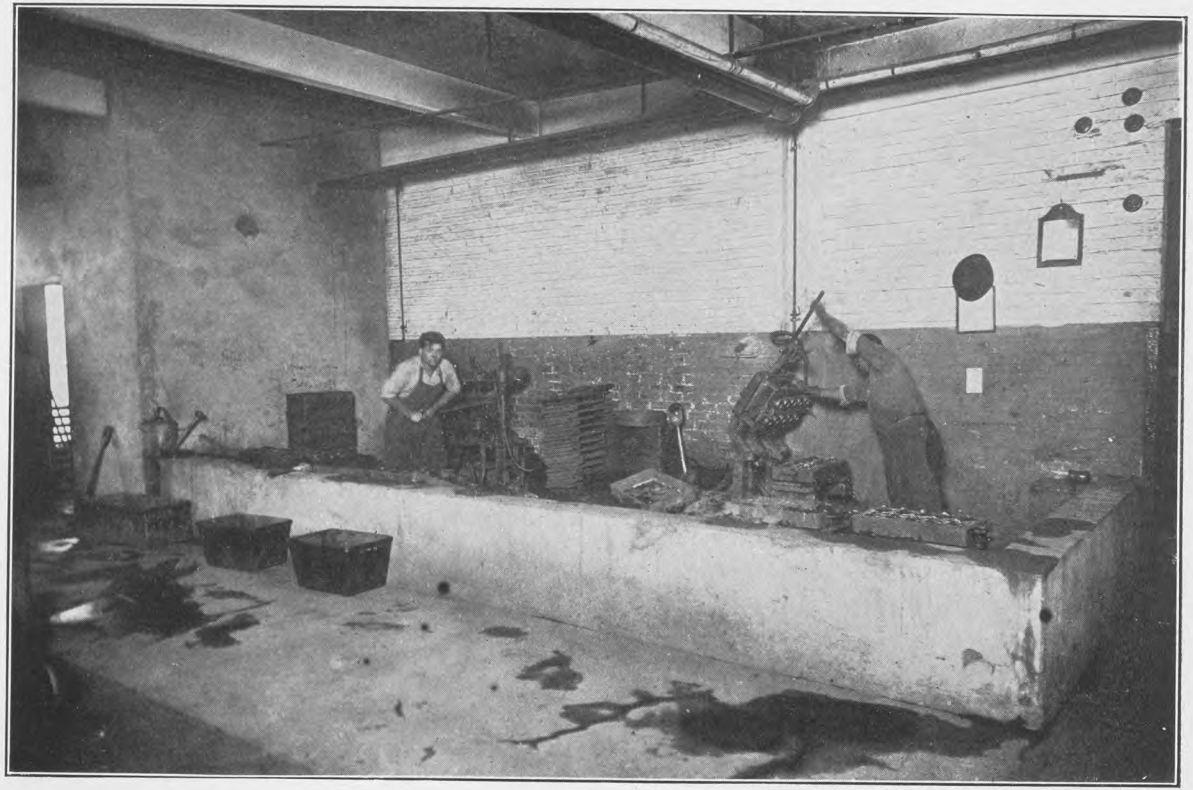

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PLATE IV.—FOUNDRY. MOLDING MACHINES.

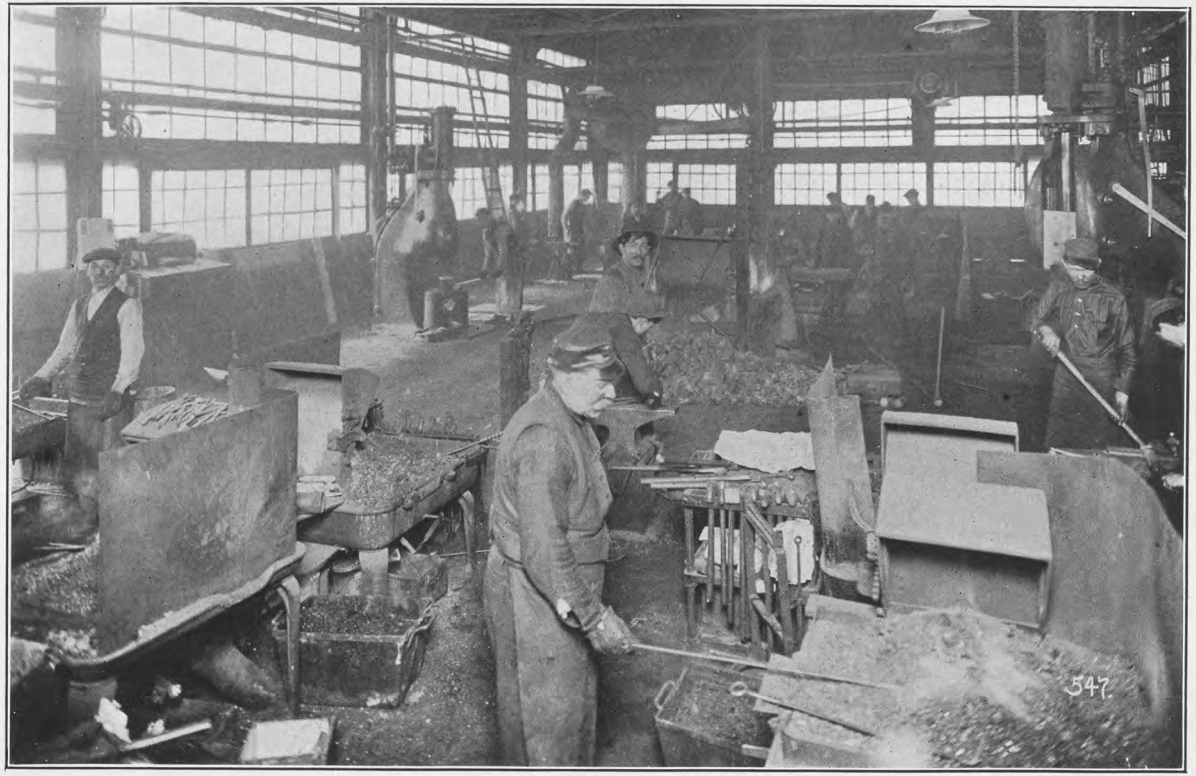

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PLATE V.—FORGE SHOP. BLACKSMITH IN FOREGROUND; FORGES AND SMALL STEAM HAMMER IN BACKGROUND.

instance, in one of the automobile-body factories inspectors in the sheet-metal department were chosen from the ranks of the markers or the rotary-shear operators,[46] and might then be promoted to the position of foreman. This situation was found in more of the factories visited than was the method of advancement reported by a large automobile factory in which inspectors of rough stock or sheet-metal parts might be selected as inspectors of enamel bodies or machine-shop products, and might then be advanced to final inspection or testing.

Laborers, truckers, and messengers, whose work brings them in contact with assembly work, pick up information which helps to fit them for an assembler's job. Assemblers who have learned how to put together some small subassembly, such as automobile pumps, may be selected because of this experience to do more complicated work, such as transmission or steering-gear assembly, and then promoted to "line work," where a gang of men work together to put the engine on the frame or do a similar piece of work.

Work in the stock room, such as that of a checker, counter, or sorter, is often considered valuable experience for an office employee or for a stock chaser. Moreover, since handling stock brings some familiarity with much of the factory work, these employees may be selected for advancement in some other department of the factory.

The description of the work of the tool designer and detailer in the drafting room [47] indicates clearly how experience in the lower-grade work is necessary for the draftsman who is going to progress.

Positions such as those of foreman, gang boss, or assistant foreman demand not only wide experience in the particular department or process supervised but also executive ability and leadership, which are not to be gained through factory experience alone. It is true, however, that experience in minor executive positions such as assistant foreman or gang boss is valuable training for a position of greater responsibility, such as that of foreman or production manager.

Training for promotion.

According to statements made by the employment managers interviewed, sufficient training to qualify the beginner for nearly all the promotions open to him in these industries could usually be secured through shop experience alone. There were a few exceptions: For instance, one employer said that he wished inspectors to have technical-school training before promoting them to machine work, and another stated that a toolmaker or tool grinder must have studied mechanical drawing either in school or in the factory drafting room before he could become a tool designer.

[46] See p. 86. [47] See p. 65.

Chances for promotion.

Actual opportunities for promotion are much fewer than would seem to be the case when only the possible line of promotion or the training for promotion is considered, since no matter how well trained the worker, his actual advancement must wait upon the occurrence of vacancies in the higher ranks or expansion of the factory. A machine hand may have the experience and ability to do the work of a machine setter, but as few are needed in the machine shop he can not hope to be promoted until one of the machine setters leaves his job. Even then there may be a dozen men as well qualified as he to fill the one position.

A typical situation illustrative of this point was seen in one of the large factories visited. The assemblers, stock and tool room workers, bench men, repair men, oilers, and laborers—about 920 in all—might become machine operators, of whom there were 820 in this plant. These in turn might become machinists or machine setters, of whom there were only 117. The final promotion to foreman or assistant foreman of the machine shop was of course possible to only a few workers. Of all the workers in the factories visited only 3 per cent were foremen or superintendents; 3 per cent machine setters, fitters, adjusters, testers, or other machinists; and 1 per cent toolmakers. Apprentices, the group who were fairly sure of promotion to a journeyman's status, constituted only 2 per cent of the total.

Promotion was not open to girls to the same extent as it was to boys. Employers who employed girls as sewing-machine, tapping, or threading-machine operators said there were no better positions open to them. In one factory employing both boys and girls as counters in the inspection department the position of foreman was open only to men. On some kinds of work, such as core making, promotion of girls was not practicable because the work to which the boys might be promoted—in this instance, molding—was too heavy for the girls.

INDUSTRIAL HISTORIES.

A study of the industrial histories of the minors in the factories surveyed brings out important facts regarding their age at first going to work, the extent of shifting from job to job, and the gain or loss incident to such changes. Although work histories secured by the questionnaire method are likely to be incomplete and to minimize and obscure the difficulties the young workers have had in attempting to find themselves industrially, the analysis indicates the need for organized effort toward making the child's transition from school to work less abrupt and costly.

For groups such as those included in this study this problem of adjustment is not primarily one which each local community can solve for itself. Four per cent had last attended school in rural

communities—25 in Michigan and 13 outside the State. Somewhat less than one-third had last attended school in the city in which they were working at the time of the study. Twenty-two per cent had come from schools in other cities in the State and 35 per cent from schools in cities outside Michigan.[48] While this is an indication that minors go from city to city and even from State to State in search of the work desired, it may have been brought about, at least in part, by the abnormal demand for workers in the Michigan factories, particularly in the automobile industry, at the time of this survey.

There seems to be little tendency among the minor workers to follow the trade in which their fathers had been engaged. Only 13 per cent had fathers who were employed in metal manufacturing and less than half (44 per cent) had fathers working in any manufacturing or mechanical industry.[49]

Age at going to work.

Many of the minors employed in the factories studied had left school for work at an earlier age than would now be permitted by the Michigan child labor and education laws.[50] Table 8 shows that 26 (3 per cent of those replying to the questionnaire) had started when under 14 years of age and of these 10 were under 12 when they began. About one-third entered industry before they were 16, while slightly over that proportion began in the single year between their sixteenth and seventeenth birthdays. The general tendency was the same among both girls and boys. The foreign-born minors, on the whole, went to work younger than the native. Of the foreign born 82 per cent, and of the native born only 64 per cent started work before they were 17 years of age.

TABLE 8.—*Age at beginning work, by sex; minors in metal-manufacturing industries.*[a]

Age at beginning work.	Minors in metal-manufacturing industries.[a]					
	Total.		Boys.		Girls.	
	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.
Total	913	100.0	818	100.0	95	100.0
Under 10 years	1	.1	1	.1	.....	.....
10 years, under 12	9	1.0	9	1.1	.....	.....
12 years, under 13	7	.8	4	.5	3	3.2
13 years, under 14	9	1.0	8	1.0	1	1.1
14 years, under 15	86	9.4	75	9.2	11	11.6
15 years, under 16	181	19.8	165	20.2	16	16.8
16 years, under 17	326	35.7	294	35.9	32	33.7
17 years, under 18	173	18.9	153	18.7	20	21.1
18 years, under 19	86	9.4	76	9.3	10	10.5
19 years, under 21	23	2.5	21	2.6	2	2.1
Not reported	12	1.3	12	1.5	.....	.....

[a] Questionnaire group.

[48] See General Table IX.

[49] See General Table VIII.

[50] See pp. 6 and 31. Some of the minors may have been subject to laws with lower standards when they left school, either laws of other States or earlier Michigan laws.

The first position.

Industry.—An indication of the shifting among minor workers, probably due in part to the desire for experiment and in part to the greater variety of opportunities open to them as they grew older, is seen in the fact that less than one-half (47 per cent) had found their first work in the metal-manufacturing industries. Table 9 shows that the tendency toward entering these industries, and manufacturing and mechanical industries in general, tended to increase with the age of beginning work.[51] This increase may be due in part to the expansion of the industry during the same period. About two-thirds, in all, had gone into manufacturing and mechanical occupations and 15 per cent into the groups classified under "Trade" or "Transportation." Forty-seven per cent of the minor workers in the automobile factories (including manufacture of automobile bodies and parts), and only 33 per cent of the foundry and machine-shop workers, reported that their first job was in the iron and steel manufacturing industries.

TABLE 9.—*Industry of first position, by age at going to work; minors in metal-manufacturing industries.*[1]

Industry of first position.[2]	Minors in metal-manufacturing industries.[1]					
	Total.	Age at going to work.				
		Under 15 years.	15 years, under 16.	16 years, under 17.	17 years, under 18.	18 years and over.
Total	100.0	100.0	100.0	100.0	100.0	100.0
Agriculture, forestry, animal husbandry	3.1	4.5	3.3	3.1	2.3	2.8
Extraction of minerals	3.4	7.1	3.3	3.4	2.3	1.8
Manufacturing and mechanical	64.5	43.7	60.2	71.8	64.2	73.4
Iron and steel	42.4	26.8	32.0	47.2	46.2	54.1
Other metal	4.5	2.7	6.6	3.4	5.2	5.5
Other manufacturing and mechanical	17.6	14.3	21.5	21.2	12.7	13.8
Transportation	6.5	9.8	6.1	5.2	9.2	3.7
Trade	8.3	16.1	9.4	6.4	6.9	7.3
Public service	.8	----	1.7	----	1.7	.9
Professional service	.7	.9	----	.3	.6	2.8
Domestic and personal service	2.2	1.8	4.4	2.1	.6	1.8
Clerical	.1	----	----	----	----	.9
Not reported	10.5	16.1	11.6	7.7	12.1	4.6

[1] Questionnaire group.
[2] The census classification of industries and occupations has been followed as closely as possible.

Duration.—Among the minors who reported that they had been at work for more than one year and who reported the duration of their first position, 11 per cent, according to Table 10, had stayed in their first jobs less than three months. Only 48 per cent had stayed a year or more. Girls remained slightly longer than boys in their first positions. Short as these periods are, a study of younger child work-

[51] A slight bias in this direction may result from the method of selection of the group, since all the children included in the study were employed in metal-manufacturing industries at the time of the investigation.

ers—between 14 and 16 years of age—in Connecticut [52] shows an even shorter duration of first positions. Of those who had been at work at least 21 months, 34 per cent had left their first jobs in less than 3 months and 48 per cent in less than 6 months.

TABLE 10.—*Duration of first position, by sex; minors in metal-manufacturing industries.*[1]

Duration of first position.	Minors in metal-manufacturing industries.[1]				
	Total.		Boys.		Girls.[2]
	Number.	Per cent distribution.	Number.	Per cent distribution.	
Total	[3] 784	.....	703	.....	81
Total reported	552	100.0	489	100.0	63
Less than 1 year	285	51.6	257	52.6	28
Less than 3 months	61	11.1	55	11.2	6
3 months, less than 6	81	14.7	77	15.7	4
6 months, less than 1 year	143	25.9	125	25.6	18
1 year and over	267	48.4	232	47.4	35
1 year, less than 1½	88	15.9	77	15.7	11
1½ years, less than 2	49	8.9	41	8.4	8
2 years, less than 2½	63	11.4	55	11.2	8
2½ years, less than 3	14	2.5	14	2.9	.....
3 years and over	53	9.6	45	9.2	8
Not reported	232	.....	214	.....	18

[1] Questionnaire group. Only those minors were included who had been at work one year or over. The few positions (36) which had lasted one year or over and had not been terminated at the time of the study were distributed according to the most probable duration.
[2] Per cent not shown where base is less than 100.
[3] Excludes 129 children (122 who had been at work less than 1 year and 7 who had not reported length of work history).

The present study indicates that the child who went to work early in life stayed in his first job longer than the child who started at a later age. Table 11 shows that the median duration of first positions decreased from 20.8 months for those beginning work under 15 to 9.3 months for those beginning at 18 years of age or over. One employer said that he considered the 18-year-old group of applicants floaters and did not wish to employ them. This tendency, together with relatively higher average age for entering manufacturing and mechanical industries,[53] may partly explain the fact that young persons entering those industries, particularly iron and steel, remained there for a shorter time on the average than those entering other kinds of work.

[52] Woodbury, Robert Morse: Industrial Instability of Child Workers, p. 18. U. S. Children's Bureau Publication No. 74, Washington, 1920.
[53] See p. 22.

TABLE 11.—*Median duration of first position, by age at beginning work; minors in metal-manufacturing industries.*[1]

Age at beginning work.	Minors in metal-manufacturing industries.[1]		Age at beginning work.	Minors in metal-manufacturing industries.[1]	
	Total.	Median duration of first position in months.		Total.	Median duration of first position in months.
Total	[2] 666	11.33	16 years, under 17	238	11.20
			17 years, under 18	129	9.84
Under 15 years	71	20.78	18 years and over	94	9.32
15 years, under 16	127	13.39	Not reported	7	.....

[1] Questionnaire group.
[2] Excludes 247 minors who did not report duration of first position.

Number of positions held.

Table 12 shows that 120, or over one-eighth of the minors included in the questionnaire survey, had each held but one position, but of these nearly two-thirds had not been at work as long as a year. On the other hand, there was much shifting from job to job. Thirty-two minors, none of whom had worked as long as two years, had each held four or more different positions. One boy who had been at work for only about three years had had nine positions in that time. These figures probably understate the number of positions held, because the minors who had shifted often might have forgotten to record all their positions. Even allowing for this possibility, the figures show a decided tendency on the part of those who had been at work for several years to stay on the job longer. For those who had been at work over five years the time spent in each position averaged more than twice as long as for those who had been at work between one and two years.

Girls had had fewer positions on the average than boys. Considerably larger percentages of the girls than of the boys had each held only one, two, or three positions, and correspondingly smaller percentages of the girls had each held four, five, or six or more. Since the work histories of the girls were only slightly shorter than those of the boys, it is thus evident that the girls tended to stay longer in their positions than the boys.

TABLE 12.—*Length of work history, by number of positions; minors in metal-manufacturing industries.*[1]

Length of work history.	Minors in metal-manufacturing industries.[1]												
	Total.		Number of positions.										
			1		2		3		4		5 [2]	6 and over.[2]	Not reported.[2]
	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.			
Total	913	100.0	120	100.0	218	100.0	193	100.0	140	100.0	81	80	81
Less than 1 year	122	13.4	75	62.5	31	14.2	9	4.7	4	2.9	1	.....	2
1 year, less than 2	159	17.4	28	23.3	59	27.1	26	13.5	17	12.1	7	3	19
2 years, less than 3	217	23.8	10	8.3	55	25.2	59	30.6	37	26.4	18	14	24
3 years, less than 4	193	21.1	4	3.3	40	18.3	51	26.4	43	30.7	23	22	10
4 years, less than 5	123	13.5	1	.8	18	8.3	27	14.0	23	16.4	19	25	10
5 years, less than 6	65	7.1	1	.8	9	4.1	16	8.3	11	7.9	11	11	6
6 years, less than 7	15	1.6	.....	.....	2	.9	4	2.1	3	2.1	1	5	.....
7 and over	11	1.2	.....	.....	2	.9	1	.5	1	.7	1	.....	6
Not reported	8	.9	1	.8	2	.9	.....	.....	1	.7	.....	.....	4

[1] Questionnaire group.

[2] Per cent distribution not shown where base is less than 100.

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Time in present occupation and industry.

In this study the time in present occupation means not the time with present employer but the time in the specific kind of work in which the boy or girl was engaged when the survey was made. If a minor had worked at several different occupations in the same factory, the time in present occupation would be shorter than the time with the present employer; but if (as was seldom the case) he had worked at the same occupation in different factories, it would be longer.

In contrast with the situation in regard to the duration of the first positions, the girls had stayed on the average a shorter time than the boys in the occupations and industries in which they were working at the time of the survey. The median time in the present occupation was 7.9 months for boys and 6.2 months for girls; the time in the present industry was 14.5 months for boys and only 9.8 months for girls. This may be due to the fact that the girls had not been at work as long on the whole as had the boys and, as already shown, more shifting occurred in the early part of industrial life.

The time in the present occupation also varied considerably for different types of work. For machine operators the median time already spent in the occupation was 12.2 months, for assemblers 10.3 months, for apprentices 7.5 months, and for inspectors 8.5 months; but for laborers' helpers and stock and tool room workers the median was only about 5 months.

Increase in earnings.

A comparison of the average weekly earnings received in the first position with the average weekly earnings in the present position [54] shows a median increase of $15.07. Only 23 (3 per cent) reported a decrease; 69 (8 per cent) reported an increase of $25 or more. The general rise of wages during the years immediately preceding the survey, which was particularly evident in the automobile and other metal-working industries, doubtless accounts for a considerable proportion of this advance.

GENERAL EDUCATION.

Two-thirds of the minors, according to Table 13, had completed the eighth or a higher grade. Not far from half of this group, 30 per cent of the whole number, recorded one or more years of high-school attendance, and of these one-sixth were high-school graduates. Among the high-school graduates six had had some further education. That as a class these workers had somewhat more than the average educational background is indicated by the fact that the

[54] Data for increase are based on the average weekly earnings in first and in present positions as obtained from the questionnaires. See General Table X.

proportion, 67 per cent, who had completed the eighth or a higher grade is larger than the average for minors of the same ages in the United States as a whole.[55]

The girls in general had not advanced so far as the boys.[56] None had graduated from high school, and only 23 per cent, as compared with 31 per cent of the boys, had completed any high-school grade. Among the nativity groups,[57] the native white children of native fathers stood highest, with 35 per cent who had advanced further than completion of the eighth grade; the native white children of foreign fathers next, with 29 per cent; and the foreign-born children last, with 20 per cent.

TABLE 13.—*Grade completed, by occupation; minors in metal-manufacturing industries.*[1]

Grade completed.	Minors in metal-manufacturing industries.[1]						
	Total.	Occupation.					
		Assemblers.	Inspectors.	Laborers and helpers.	Machine operators.	Stock and tool room workers.	Other.
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Third grade and lower	0.9	.....	.....	1.6	0.5	.....	1.9
Fourth grade	1.8	2.8	1.6	4.1	1.5	.....	1.2
Fifth grade	3.8	0.9	2.3	8.9	3.6	1.0	4.7
Sixth grade	7.9	8.5	1.6	14.6	4.6	7.9	10.1
Seventh grade	15.8	18.9	14.8	12.2	18.3	16.8	14.3
Eighth grade	36.7	41.5	37.5	36.6	41.1	35.6	31.4
First year high school	11.7	8.5	18.0	4.9	11.7	12.9	12.8
Second and third year high school	13.0	12.3	16.4	6.5	12.2	19.8	12.8
Fourth year high school and higher education	5.0	4.7	7.8	2.4	4.6	5.0	5.4
Not reported	3.4	1.9	.....	8.1	2.0	1.0	5.4

[1] Questionnaire group.

The educational opportunities of these minors may have varied with the localities where they had lived while they were going to school.[58] Most of them had come from city schools; only 38, or about 1 in 25, had last attended school in a rural community. But since the figures show only the locality of the school last attended and not the period of attendance, no significance can be attached to the differences in the proportions of children from different types of schools who had completed specified grades.

[55] It is estimated that only 63.4 per cent of the children in the United States who enter the first grade enter the eighth grade. Bonner, H. R., Statistics of Universities, Colleges, and Professional Schools, 1917–18, p. 30, U. S. Bureau of Education, Bulletin, 1920, No. 34. Washington, 1921.

[56] See General Table XI.

[57] See General Table XI. The negro group was considered too small to be included in this comparison.

[58] See General Table IX.

Grade completed and occupation.

The demands of the occupations in which the minors were engaged constitute a further factor in determining the general educational qualifications of the occupational groups. For nearly all the occupations in which minors were commonly employed—such as apprentice, assembler, inspector, and machine operator—most employers preferred workers with an eighth-grade education, though in some cases (especially for machine operators) the sixth or seventh grade was equally acceptable. Others, while believing that a common-school education was necessary for advancement, did not consider it an indispensable qualification for entrance upon the work of the factory. A high-school education, at least, was thought necessary for chemists, melter's assistants, toolmaker's apprentices, and for a few other technical jobs. Employers were less likely to make any educational requirements for laborers and helpers, and for the simpler types of stock and tool-room work. It is therefore not surprising to find, as is shown in Table 13, that although only 67 per cent of all the minors had completed the eighth or a higher grade, 80 per cent of the inspectors and 70 per cent of the machine operators had done so, as compared with 50 per cent of the laborers and helpers.

In a few cases the employer's demand of a common-school education was caused by the nature of the work. One employer, for instance, employed eighth-grade graduates as millwright's helpers because they needed some knowledge of mathematics; another preferred them for skilled inspection work and for machine operators because they had to learn to read blue prints. On the other hand, a study of the work done in those occupations for which completion of the eighth grade was usually held necessary [59] shows that often this degree of general education was demanded not because it was needed in the actual performance of the job but because it indicated a level of general intelligence and mental training which the employer thought desirable in the performance of even the relatively simpler types of work.

Grade completed and earnings.

Although wages tended to increase with years of industrial experience (up to six years) the median hourly earnings of minors who had completed specified grades, as shown in Table 14, indicate that preliminary education often more than offsets experience as a factor in earning power. High-school graduates, who as a group reported a median work history of slightly less than two years, showed median hourly earnings of 67 cents, or 5 cents an hour more than was reported for the whole group who had worked two years but less than three. The median expected earnings for this group would have been only

[59] See p. 63 et seq. for descriptions and requirements of occupations.

61 cents an hour.[60] The same tendency is shown at the other end of the scale, for while those who had completed only the seventh grade or less reported median work histories of slightly over three years and actual median earnings of 60 cents an hour, the expected [60] median earnings would be 64 cents an hour.[61] In spite of relative inexperience in the factory, the median earnings of the young persons who had gone beyond the first year of high school were 7 cents an hour more than those received by the workers who had not completed the sixth grade.

TABLE 14.—*Median hourly earnings and median length of work history, by grade completed; minors in metal-manufacturing industries.*[1]

Grade completed.	Minors in metal-manufacturing industries.[1]		Grade completed	Minors in metal-manufacturing industries.[1]	
	Median earnings per hour.	Median length of work history.		Median earnings per hour.	Median length of work history.
	Cents.	*Yrs. Mos.*		*Cents.*	*Yrs. Mos.*
Total	62.9	2 9	First-year high school	60.5	2 6
Sixth and lower grades	62.4	3 3	Second and third year high school	67.8	2 7
Seventh grade	58.2	3 —	Fourth-year high school and higher education	67.1	1 11
Eighth grade	63.9	2 9			

[1] Questionnaire group.

These differences are, to be sure, rather small, but the money value of an education can not of course fairly be measured by a study of earnings received only by workers under 21. They are not mature enough and have not been at work long enough to acquire the experience necessary for positions demanding much knowledge, skill, or responsibility. Furthermore, the additional experience gained by those who cut short their school life to go to work gives them an initial advantage over those who stay in school longer which later disappears.

Age at leaving school and retardation.

A correlation of grade completed and age at leaving school gives a rough index of retardation, even though standards may vary from school to school. Of the minors reporting the age at which they had left school and the grade they had completed, as shown by Table 15, 3 per cent had left school before they were 14 years of age; and 38 per cent had left between their fourteenth and sixteenth birthdays. Practically the same number left in the single year after they were 16 as in the two previous years. A somewhat larger number left school at the ages of 14 and 15 years than went to work in those years,

[60] Expected on the basis of wages earned by all minors with the same duration of industrial experience.
[61] See also Table 6.

indicating a transition interval between school and work.[62] No definite conclusion as to the amount of schooltime lost in this interval can be drawn, however, because it is not known in how many cases the interval occurred when school was not in session. The average age at leaving school was higher for the minors included in this study than was found in a study of working boys 16, 17, and 18 years of age in New York State,[63] made in 1918. In cities of over 25,000 inhabitants, excluding Greater New York,[64] 3 per cent left school before they were 14 years of age and 61 per cent between the ages of 14 and 16 years.

TABLE 15.—*Retardation, by age at leaving school; minors in metal-manufacturing industries.*[1]

Age at leaving school.	Minors in metal-manufacturing industries.[1]									
	Total.	Retarded.						Normal.		Advanced.	
		Total.		1 and 2 years.		3 years and over.					
		Number.	Per cent.[2]	Number.	Per cent.[2]	Number.	Per cent.[2]	Number.	Per cent.[2]	Number.	Per cent.[2]
Total	[3] 867	453	52.2	375	43.3	87	9.0	347	40.0	67	7.7
Under 14 years	27	7	.....	5	.....	2	.....	9	.....	11	.....
14 years, under 15	113	32	28.3	29	25.7	3	2.7	67	59.3	14	12.4
15 years, under 16	220	88	40.0	72	32.7	16	7.3	122	55.6	10	4.5
16 years, under 17	335	248	74.0	213	63.6	35	10.4	75	22.4	12	3.6
17 years and over	172	78	45.3	56	32.6	22	12.8	74	43.0	20	11.6

[1] Questionnaire group.
[2] Not shown where base is less than 100.
[3] Excludes 46 minors for whom age at leaving school or grade completed was not reported or who were still in part-time day school or working on vacation permits.

A large percentage of the minors, as shown by Table 15, had not completed normal grades for their ages, even under the comparatively conservative standard adopted for this report. According to that standard, a child who left school at 14 years of age was considered to have made normal progress if he had successfully passed through either the seventh or the eighth grade; one who had left at 15 years of age[65] was held to have completed a normal grade if he had finished the eighth grade or one year of high school; and so on. On this basis, 52 per cent of the minors had failed to complete normal grades for their ages, and a sixth of these—nearly 1 in 10 of the whole group—were three or more years retarded.

[62] See Table 8.

[63] Burdge, Howard G.: Our Boys, A study of 245,000 16-, 17-, and 18- year-old employed boys of the State of New York, p. 89. New York Military Training Commission, Bureau of Vocational Training, Albany, 1921.

[64] This group is used as most comparable with the cities included in the Michigan study.

[65] Even if a child did not start his school life until 7 years of age, which was the age required by the Michigan compulsory education law and by the laws of most of the States, he would have completed the eighth grade at the age of 15 years if he had gone straight through the grades.

A survey of the public schools in 80 representative cities in the United States, made by the United States Bureau of Education for the school year 1917–18, showed among all the pupils in school an average of only 21 per cent retarded,[66] but these figures included children of all ages. The proportion of retardation among the minors included in this survey was also higher than was found in the New York study previously referred to,[67] which showed that in cities of over 25,000, excluding Greater New York, 47 per cent of the boys who had left school between the ages of 14 and 17 were retarded, as compared with 55 per cent of the corresponding group of minors included in the present study. In a study of working children between 14 and 16 years of age in Boston, where the same standard was used as in this study, it was found that slightly less than one-third of the children included had failed to complete normal grades, and a somewhat larger percentage than in this study had completed grades higher than normal for their ages.[68]

While both the Boston and the Michigan figures indicate that the tendency to drop out of school and go to work may be more marked among backward than among normal children, the larger percentage of retarded Michigan children is due at least in part to the higher age standard of the law relating to attendance of children at school.[69] The Michigan statute, with certain rather restricted exemptions,[70] required all children between 7 and 16 years of age to attend school until they had completed the eighth grade. Of the minors who had last attended school in Michigan—nearly three-fifths of the entire group[71]—those who could not finish the eighth grade at 14 or 15 had been required to stay on in school. The child who would be recorded as in a normal grade if he dropped out of school in one of the lower grades might be considerably below the normal when he finally succeeded in completing the eighth grade, or when he reached 16 without having advanced even as far as the eighth grade. It is

[66] Bonner, H. R.: Statistics of City School Systems, 1917–18, p. 35. U. S. Bureau of Education Bulletin, 1920, No. 24, Washington, 1920. The standard of retardation used by the Bureau of Education was slightly lower than that used in this study.

[67] Burdge, Howard G.: Our Boys: A study of 245,000 16, 17, and 18 year old employed boys of the State of New York, p. 89. New York Military Training Commission, Bureau of Vocational Training, Albany, 1921.

[68] The percentage of the Boston children who had completed higher grades than normal was 9.6 among all the children for whom continuation-school records were obtained. The Working Children of Boston: A study of child labor under a modern system of legal regulation, p. 134. U. S. Children's Bureau Publication No. 89, Washington, 1922.

[69] In Massachusetts a child of 14 could leave school to go to work if he had "such ability to read, write, and spell in the English language as is required for the completion of the fourth grade of the public schools in the city or town in which he resides." (Revised Laws 1902, ch. 44, sec. 1, as amended by acts of 1913, ch. 779, sec. 1, and by acts of 1915, ch. 81, sec. 1.) Since the period of that study the educational requirement has been raised to completion of the sixth grade. (Acts of 1921, ch. 463.)

[70] Sixth-grade graduates 14 years of age or over whose labor was necessary for support of parents were exempted. There were also the usual exemptions for physical and mental disability and, for children 12-14, an exemption allowing attendance at confirmation classes. (Howell's Annotated Statutes 1913, sec 10110, as amended by acts of 1917, No. 179, and acts of 1919, No. 132.)

[71] See General Table IX.

therefore natural to find the highest proportion of retardation, 74 per cent, and the lowest proportion of minors advanced for their ages, 3.6 per cent, in the group who left school when they were 16.

TECHNICAL TRAINING.

School courses in technical subjects.

Courses pursued.—The need of a good elementary education was more frequently emphasized by employers than the need for technical vocational education, since much of the technical knowledge necessary for specialized types of work could be secured by actual experience. Nevertheless, most employers believed that vocational training was of value for the more skilled work, especially that of machine operators, machinists, toolmakers, painters, draftsmen, designers, testers, chemists, and apprentices in all types of metal manufacturing. A few employers considered special vocational work valuable for outfit assemblers, bearing setters, final inspectors, and those employed at other types of assembling and inspection. Naturally, therefore, minors who had taken such courses had better opportunities than others to secure work of this sort. A considerably larger proportion of the machine operators, assemblers, and inspectors than of the laborers and helpers had at some time taken metal-trades courses.[71a]

Of the minors included in the study who had taken courses of that kind after leaving school about one out of every four was a machine operator, and nearly the same proportion were assemblers and inspectors, while only 1 out of 20 was a laborer and helper. The same tendency, but to a less degree, was found in the group taking metal-trades courses before leaving school.[72]

In spite of the value attached to technical training by most of the employers, the growing emphasis in the schools on vocational work, and the increasing opportunities for such training open to those who have left school, only 15 per cent of the boys and none of the girls had at any time received training that would especially fit them for employment in a metal-working factory. Even in these cases the training may not have been such as to fit the minor directly for the occupation in which he was engaged.

Table 16 shows that about one-fourth of the minors—nearly three-tenths of the boys and over one-tenth of the girls—had taken trade training courses of some kind either in day school or after they had left school. A smaller proportion had pursued these courses after leaving school than before, and a few—about 1 in 20—had taken vocational work during both periods. Of the 59 boys who took

[71a] This term is used throughout this report to cover all courses, including mechanical drawing and drafting, which would especially fit the minor for any kind of employment in a metal-working factory.

[72] See General Table XII.

metal-trades courses while in day school only 14 followed them by additional courses along the same line after leaving day school.[73]

A larger proportion of the minors who last attended school in the same city in which they were found working than of those who last attended school elsewhere had taken vocational training in day school, since in all the cities included in the survey the schools provided some kind of trade training courses. Only 1 of the 38 minors who came from rural schools had had vocational work.

TABLE 16.—*Time of taking trade training courses, by sex; minors in metal-manufacturing industries.*

Time of taking trade training courses.	Minors in metal-manufacturing industries.					
	Total.		Boys.		Girls.	
	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.
Total	[1] 807	100.0	734	100.0	73	100.0
Taking courses	221	27.4	213	29.0	8	11.0
In day school only	103	12.8	100	13.6	3	4.1
After leaving day school	82	10.2	77	10.5	5	6.8
Both	36	4.5	36	4.9	.....	.....
Taking no course	586	72.6	521	71.0	65	89.0

[1] Excludes 106 minors who did not report whether or not any courses were taken.

Trade training and grade completed.—The minors who had progressed furthest in school were the ones most likely to have had vocational training courses, chiefly because at least a sixth-grade education is usually a prerequisite to such courses. All those who had taken vocational courses in day school had gone beyond the fourth grade. Table 17 shows that all but 6 per cent of those who took vocational work while still in day school had gone beyond the sixth grade, 83 per cent had completed the eighth grade or some high-school work, and 60 per cent had received at least one or more years of high-school training.

Types of courses.—Metal-trades courses, as shown by Tables 18 and 19, were taken by a much larger proportion of the boys who secured some vocational training after they stopped going to school regularly than of those who took courses while they were still in day school (69 as compared with 43 per cent). The most popular types of these courses taken after leaving day school were mechanical drawing and drafting, tool or pattern making, and automobile repair or assembly. In the comparatively few cases where a minor had taken more than one course, however, preference in tabulating the material was given to the courses in the order in which they are

[73] See General Table XIII.

listed in the table; it was not practicable to tabulate more than one course for each minor. Therefore, if all who reported each course could have been counted, slightly larger numbers would have been shown in the courses toward the end of the list.

TABLE 17.—*Grade completed and whether or not trade training courses were taken in day school; minors in metal-manufacturing industries.*[1]

Grade completed.	Minors in metal-manufacturing industries—[1]					
	Total.		Who had taken courses in day school.		Who had taken no courses in day school.	
	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.
Total	[2] 873	100.0	139	100.0	734	100.0
Sixth and lower grades	129	14.8	8	5.8	121	16.5
Seventh grade	138	15.8	13	9.4	125	17.0
Eighth grade	325	37.2	33	23.7	292	39.8
First year high school	104	11.9	31	22.3	73	9.9
Second and third year high school	115	13.2	38	27.3	77	10.5
Fourth year high school and higher education	46	5.3	14	10.1	32	4.4
Not reported	16	1.8	2	1.4	14	1.9

[1] Questionnaire group.
[2] Excludes 40 who did not report whether or not trade training courses were taken in day school.

TABLE 18.—*Type of trade training courses taken in school, by sex; minors in metal-manufacturing industries.*[1]

Type of trade training courses taken in day school.	Minors in metal-manufacturing industries who took training courses in day school.[1]				
	Total.		Boys.		Girls.[2]
	Number.	Per cent distribution.	Number.	Per cent distribution.	
Total	139	100.0	136	100.0	3
Metal trades	59	42.4	59	43.4	.....
Tool and pattern making	17	12.2	17	12.5	.....
Mechanical and electrical engineering	2	1.4	2	1.5	.....
Mechanical drawing and drafting	30	21.6	30	22.1	.....
Machine-shop practice	5	3.6	5	3.7	.....
Foundry	2	1.4	2	1.5	.....
Automobile repair and assembly	2	1.4	2	1.5	.....
Other	1	.7	1	.7	.....
Woodworking	22	15.8	22	16.2	.....
Commercial	16	11.5	14	10.3	2
All other	33	23.7	32	23.5	1
Not reported	9	6.5	9	6.6	.....

[1] Questionnaire group.
[2] Per cent distribution not shown where base is less than 100.

TABLE 19.—*Type of trade training courses taken after leaving day school, by sex; minors in metal-manufacturing industries who took trade training courses after leaving school.*[1]

Type of trade training courses taken after leaving day school.	Minors in metal-manufacturing industries who took trade training courses after leaving school.[1]				
	Total.		Boys.		Girls.[2]
	Number.	Per cent distribution.	Number.	Per cent distribution.	
Total	118	100.0	113	100.0	5
Metal trades	78	66.1	78	69.0	.....
Tool and pattern making	17	14.4	17	15.0	.....
Mechanical and electrical engineering	7	5.9	7	6.2	.....
Mechanical drawing and drafting	17	14.4	17	15.0	.....
Machine-shop practice	10	8.5	10	8.8	.....
Foundry	1	.8	1	.9	.....
Automobile repair and assembly	15	12.7	15	13.3	.....
Other metal trades	11	9.3	11	9.7	.....
Woodworking	1	.8	1	.9	.....
Commercial	13	11.0	10	8.8	3
All other	20	16.9	18	15.9	2
Not reported	6	5.1	6	5.3	.....

[1] Questionnaire group. [2] Per cent distribution not shown where base is less than 100.

Only one-fourth of the minors who had taken courses after leaving day school took them in the public schools.[74] A large number—nearly two-thirds as many as had taken courses in public schools—had taken them in correspondence schools, and the proportion of minors who had taken metal-trades courses was about the same. Factory courses had been taken by about the same number as had taken correspondence courses. The other courses reported had been taken at various types of private schools such as business colleges or automobile schools. The name of the city in which the work was taken was not obtained, and there is consequently no method of determining whether the work taken in private courses and by correspondence could have been secured at the time in the public schools; but since nearly one-third of the minors had last attended school in the city in which they were working, and over one-half had done so in some Michigan city, it would seem that there had been a demand for vocational training not satisfied by the public schools available to these minors.

Length of courses.—Three-tenths of the minors who reported the length of the courses taken since leaving day school had taken courses which lasted for a year or more, and over five-sixths had taken courses extending over a period of at least three months.[75] Nearly two-thirds of the minors who reported the length of courses taken while they were still in day school had attended such courses 12 months or more and only about one-fifth had attended less than 6 months.

Relation to earnings.—The value of the vocational training of these minors could not be shown fully by the amounts which they were earning at the time of this study not only because many of them had not been at work long enough to have put their training to full practical use but also because for such a determination it would be necessary to discover whether in time of depression the trained man

[74] See General Table XIV. [75] See General Table XV.

was retained in preference to the one not trained. Under these conditions even a slight difference in earnings is significant. Boys who had taken metal-trades courses were receiving a median wage of 66 cents an hour and $31.96 a week, while those who had taken no trade training courses at all reported 65 cents an hour and $30.26 a week. Fifty-five per cent of the boys who had taken courses in metal trades and only 44 per cent of those who had no trade training courses were earning $30 a week or more.

Shop training and apprenticeship.

For many occupations employers did not require workers with any experience. In one establishment employees who had not worked in other plants were even preferred, because it was believed they could be trained more quickly to the routine of the particular factory. For work requiring a small amount of experience, the general practice was to take unskilled workers already in the factory and train them. For work requiring much skill and training, such as that of welders, machine operators, and machinists, men who had had experience in other factories were preferred.

The general lack of any definite method of learning the occupation in the factory is shown by the fact that 44 per cent of the workers failed to report how the training for the jobs in which they were working had been secured. Nearly all of those who gave any reply had "picked it up" or had been shown by the foreman, 6 per cent had worked as helpers, 6 per cent as apprentices, and 4 per cent stated they received their training through school courses.

Learning period.—It was equally difficult to obtain complete information concerning the duration of the training for the work which the minor employees were doing at the time of the survey. Forty-two per cent made no reply to this query. Naturally those who had no definite idea of how they had learned their work could make no reply as to the time required; but since it is reasonable to suppose that some (particularly the apprentices) who did not reply considered that they had not yet "learned" their work, the proportion shown by Table 20 as having spent any considerable time in learning may be an understatement. Only about 1 in 6 of the entire number reporting on this point had spent as much as six months in learning. Nevertheless the large proportion who had spent very short periods is corroborated by the testimony of employment managers as to the time necessary for workers to become proficient in the various types of occupation. It was the general opinion that less than one day was required for truckers, messengers, errand boys, and most of the laborers. The time necessary for learning the simpler types of assembling, inspection, and machine operating was estimated at between a week and a month. On the other hand, a year or more was needed for many of the skilled occupations.[76]

[76] See data under heading "Learning period" in Descriptive Analysis of Common Occupations of Minors, p. 63 et seq.

TABLE 20.—*Time spent in learning present occupation, by kind of occupation; minors in metal-manufacturing industries.*[1]

Occupation.	Minors in metal-manufacturing industries.[1]																	
	Total.	Time spent in learning present occupation.																
		Less than 1 day.		1 day, less than 1 week.		1 week, less than 1 month.		1 month, less than 3.		3 months, less than 6.		6 months, less than 1 year.		1 year, less than 2.		2 years and over.		Not reported.	
		Number.	Per cent.[2]	Number.	Per cent.[2]	Number.	Per cent.[2]	Number.	Per cent.[2]	Number.	Per cent.[2]	Number.	Per cent.[2]	Number.	Per cent.[2]	Number.	Per cent.[2]	Number.	Per cent.[2]
Total	913	34	3.7	118	12.9	193	21.1	79	8.7	21	2.3	31	3.4	19	2.1	32	3.6	386	42.3
Apprentices	42	1	.....	1	.....	2	.....	1	.....	1	.....	1	.....	1	.....	.....	.....	34	.....
Assemblers	106	5	4.7	20	18.9	22	20.8	19	17.9	1	.9	3	2.8	3	2.8	3	2.8	30	28.3
Inspectors	128	4	3.1	13	10.2	22	17.2	16	12.5	5	3.9	4	3.1	4	3.1	4	3.1	56	43.8
Laborers and helpers	123	3	2.4	30	24.4	13	10.6	4	3.3	.....	.....	2	1.6	.....	.....	.....	.....	71	57.7
Machine operators	197	7	3.6	20	10.2	49	24.9	13	6.6	8	4.1	9	4.6	7	3.6	9	4.6	75	38.1
Drills	33	3	.....	2	.....	11	.....	3	.....	3	.....	1	.....	.....	.....	1	.....	9	.....
Grinders	40	.....	.....	3	.....	11	.....	2	.....	3	.....	2	.....	1	.....	.....	.....	18	.....
Lathes	28	1	.....	3	.....	4	.....	3	.....	1	.....	2	.....	3	.....	5	.....	6	.....
Milling machines	37	.....	.....	3	.....	12	.....	1	.....	1	.....	1	.....	1	.....	2	.....	16	.....
Other machines	59	3	.....	9	.....	11	.....	4	.....	.....	.....	3	.....	2	.....	1	.....	26	.....
Stock and tool-crib workers	101	4	4.0	16	15.8	16	15.8	7	6.9	2	2.0	2	2.0	1	1.0	1	1.0	52	51.5
All others	216	10	4.6	18	8.3	69	31.9	19	8.8	4	1.9	10	4.6	3	1.4	15	6.9	68	31.5

[1] Questionnaire group.

[2] Not shown where base is less than 100.

Apprenticeship.—The basic reason for the breakdown of the apprenticeship system under modern factory conditions—a rapidly increasing specialization of labor which has reduced the demand for the all-round skilled workman—has been operative in the metal industries. The Cleveland Survey [77] points out clearly the chief difficulties found in practical attempts to revive this type of training in, for example, the machinist's trade. The minute subdivision of processes made possible by the perfection of machine tools has had a deterrent effect upon both employer and employee—the employer finds his attempt to train apprentices a disadvantage to himself because he has no guaranty of keeping them after he has trained them, and the apprentice sees the worker who has specialized in one machine process earning much more than he during his first years of industrial life, and nearly as much even after his years of apprenticeship are over. No attempt at state-wide formulation of standards of training, service, and compensation, such as that which has brought about a decided development of the apprenticeship system in Wisconsin,[78] has been made in Michigan, though in a few industrial plants standards have been carefully worked out. Only 9 of the 20 employers interviewed reported any organized system of training apprentices for any trades.

The classification "apprentice" as used in this report included not only those minors at work under apprenticeship agreements, but also those who were working directly under skilled journeymen with a prospect of promotion to a journeyman's position after sufficient experience. Even when the significance of the term was thus broadened it was found that only 7 per cent of the minors included in the survey could be classified as apprentices. Their median hourly wage was 51 cents—lower than for boys in any other of the main occupation groups,[79] but high when compared with the wages usually provided for in apprenticeship agreements [80] in these and similar industries. This fact may be due to the inclusion, already mentioned, of helpers; but it may also be due in part to the scarcity of labor and the unusually high level of wages at the time of the study.

When the entire working history of the minors included in the survey was considered, it was found that 12 per cent of those who replied to this query had served an apprenticeship at some trade and

[77] Lutz, R. R.: The Metal Trades [Cleveland Educational Survey], p. 21 et seq. The survey committee of the Cleveland Foundation, Cleveland, 1916.

[78] Douglas, Paul H., American Apprenticeship and Industrial Education. Studies in History, Economics, and Public Law, Whole Number 216, pp. 78–80. Edited by the faculty of political science of Columbia University. New York, 1921. See also The Apprenticeship Law with Explanations, issued December 1, 1921, by the Industrial Commission of Wisconsin.

[79] See Table 7.

[80] See apprenticeship agreement described on p. 39. See also Lutz, R. R.: The Metal Trades [Cleveland Educational Survey], p. 28, and Apprenticeship in Wisconsin, Third Report, Industrial Commission of Wisconsin. Madison, 1919.

8 per cent of the whole number reporting at some one of the metal trades. The diversity of trades in which the minors had received this type of training is shown in Table 21. The largest number found in any single occupation group—18, or nearly one-fifth of those reporting apprenticeship—had been tool or die maker's apprentices.

TABLE 21.—*Trade of apprenticeship; minors in metal-manufacturing industries.*[1]

Trade of apprenticeship.	Minors in metal-manufacturing industries.[1]		Trade of apprenticeship.	Minors in metal-manufacturing industries.[1]	
	Number.	Per cent distribution.		Number.	Per cent distribution.
Total	[2] 812	100.0	Apprenticed—Continued.		
			Metal trades—Continued.		
Apprenticed	95	11.7	Automobile mechanic	9	1.1
Metal trades	66	8.1	Other metal	27	3.3
Tool and die maker	18	2.2	Draftsman	1	.1
Pattern maker	3	.4	Trimmer	1	.1
Sheet-metal worker	1	.1	Electrician	2	.2
Coppersmith	2	.2	Printer	3	.4
Core maker and molder	3	.4	Woodworker	3	.4
Blacksmith	3	.4	Other	19	2.3
			Not apprenticed	717	88.3

[1] Questionnaire group.

[2] Excludes 101 who did not report.

The most complete and extensive apprenticeship system found was in one of the large automobile factories which maintained an apprenticeship school to train toolmakers, machinists, tool and jig designers, and automobile mechanics. This school, which had been in operation two years, had an enrollment of 145 apprentices, many of whom had come from outside the State. A schoolroom, a school machine shop, and four full-time instructors, were provided, in addition to regular factory work. An applicant served two months before entering into the regular apprenticeship agreement, by which he (and his guardian for him) promised to serve the employer faithfully and pursue such classroom studies as the company might require. On the other hand, the employer agreed to give the apprentice adequate training in his trade and to give him a certificate upon the successful completion of his work. The company could discharge the apprentice for inability to work, disobedience, or improper conduct, and could "rearrange his working times if the state of business should demand it." The agreement also specified the wage to be paid. Four types of apprentices were accepted: (1) Junior apprentices, eighth-grade, but not high-school, graduates 16 to 20 years of age, who might be admitted to a three-year course. Beginning at 22½ cents an hour, they were given increases of 4½ cents, 3 cents, 3 cents, 3 cents, and 4 cents, respectively, every six months. (2) Senior apprentices, high-school graduates of any age, who might enter a 2½-year course. Beginning at 32½ cents an hour they received increases of 2½ cents

every 6 months. (3) Returned soldiers of any age, who might enter a 2-year course. In the case of disabled soldiers the factory cooperated with the Government in providing training. (4) High-school students taking industrial courses, who might arrange to spend alternate weeks in the factory and the school and receive credit in high school for their work in the factory as junior apprentices.

Other factories included in this study were training apprentices to some extent. One foundry and machine shop was just initiating an apprenticeship system, under which the apprentice agreed to study mathematics and mechanical drawing in a technical night school two nights a week for six months each of the two years during which he was serving his apprenticeship. The employment manager was not very sanguine of results, because, as he said, inexperienced boys could soon earn high wages as machine operators, and so had little incentive to become skilled machinists. Another firm which had formerly made a practice of training its boiler makers and sheet-metal workers through a 5-year apprenticeship had, at the time of the survey, only two such apprentices on the pay roll. In a few other factories some apprenticeship training was offered, though no formal agreement or course of instruction existed.

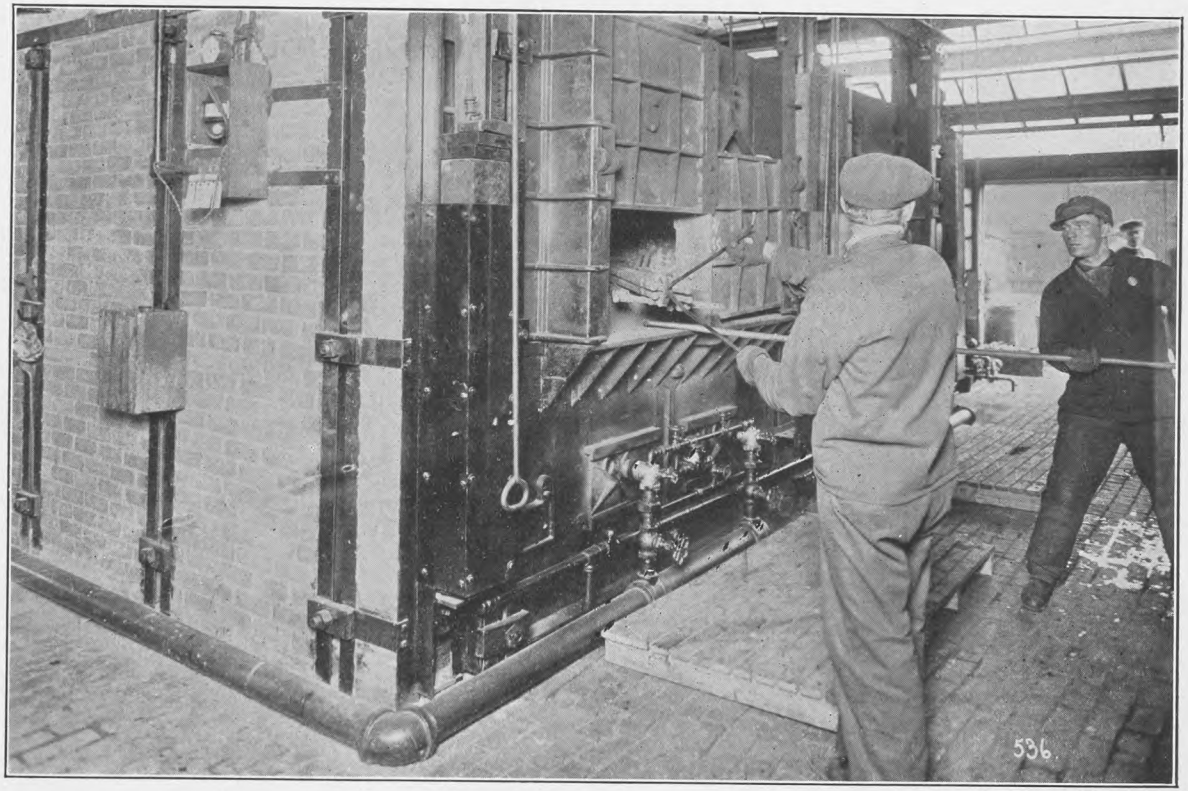

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PLATE VI.—HEAT TREATMENT. HEATING FURNACE.

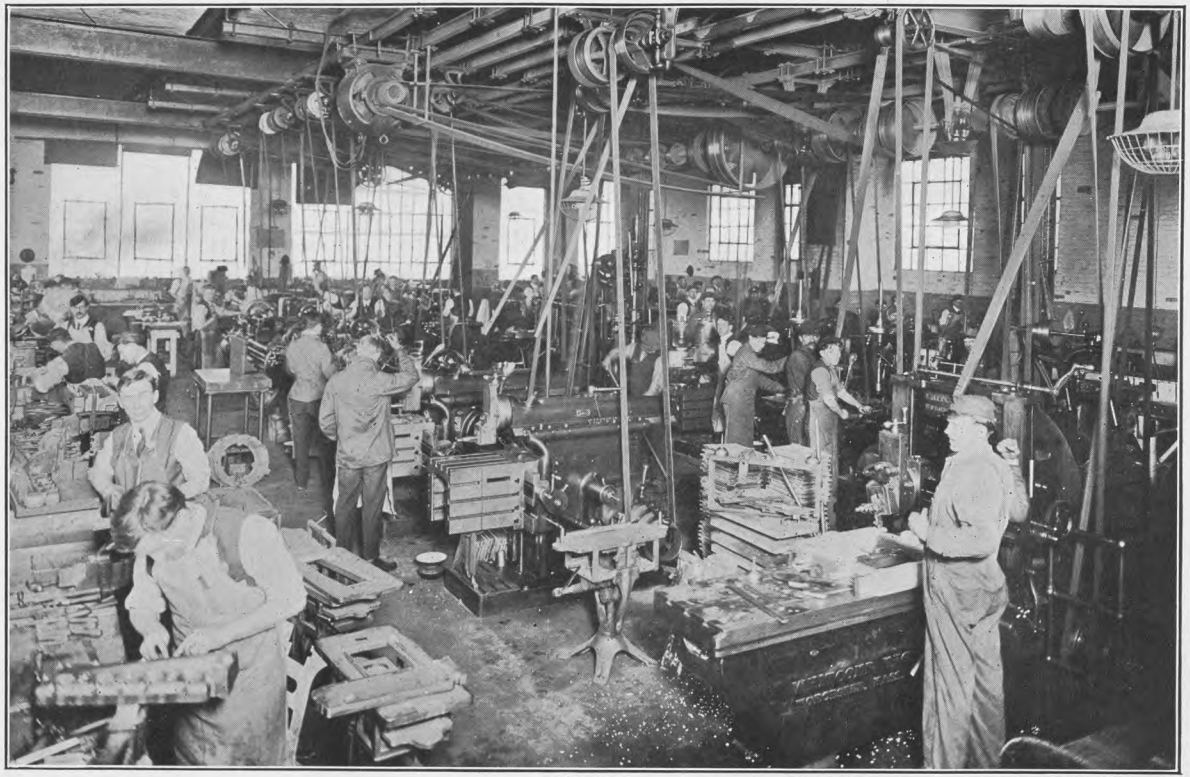

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PLATE VII.—MACHINE SHOP. PLANER IN FOREGROUND AT RIGHT, SHAPERS NEXT; BENCH WORK AT LEFT.

TECHNICAL TRAINING FOR WORKING MINORS IN THE SELECTED CITIES.

Opportunity for some type of school training for machine-shop, foundry, or other factory work was available in the public schools in all the cities visited, and in three—Detroit, Lansing, and Saginaw—the trade and industrial courses offered met standards for Federal aid under the Smith-Hughes Law.[81]

DETROIT.

The city schools in Detroit were well equipped to furnish many kinds of vocational training. All-day, part-time, and evening courses in a large number of technical and vocational subjects were given in the Cass Technical High School.

Continuation schools.

Since training of minors who had already entered industry was of particular interest in connection with this report, special attention is here directed to the continuation and evening schools. At the time of this study all children below the age of 16 employed under work permits or excused from school to help at home, and all working children between 16 and 18 who had not completed the eighth grade, were required by the Michigan law to attend continuation school for four hours a week wherever such schools had been established. Establishment was optional with the local school authorities,[82] and Detroit was the only city making provision for this type of school.[83]

Boys' continuation school.—The total enrollment for the year 1919–20 in the boys' continuation school was about 1,000; 618 boys were in school at the time the study was made. Practically all of them (93 per cent) were between 15 and 16 years of age; 6 per cent were 16 years of age or over. In other words, practically all the children enrolled were required by law to attend. Table 22 shows that the largest single group, 40 per cent, had completed the seventh

[81] 39 U. S. Stat. L. 929.

[82] Acts of 1917, Act No. 280.

[83] The continuation school law, passed in 1919, which went into effect September 1, 1920, after the survey was completed, made the establishment of continuation schools compulsory in districts having a population of 5,000 or more and containing 50 or more children subject to the provisions of the act, permitted the establishment of such schools in smaller districts and required attendance when schools were established, increased the required hours of attendance from four to eight per week , and required attendance, with certain exemptions, of all working children under 18 who had not completed a four-year high-school course or its equivalent. (Acts of 1919, Act No. 421.) In 1921 the law was further amended to apply only to unmarried minors under 17, exempting those who had completed two years of a four-year high-school course. (Acts of 1921, First Extra Session, Act No. 15.)

grade; less than 1 per cent were from lower grades, and over one-third had had some high-school work.

The course of study which each boy was to pursue was decided on the basis of his education, his present job, and his desired vocation. He was advised in his choice by the director of the continuation school or his representative and sometimes also by his employer. About two-fifths of those reporting their courses were taking the following subjects: History, civics, mechanical drawing, and mathematics. Of these over one-fourth were taking in addition courses in electrical construction, typing, or printing. A total of 513 minors were enrolled in mathematics classes, 484 in mechanical drawing, 220 in machine shop, and 100 in typing. About seven-tenths of all the students were taking three courses or more.

TABLE 22.—*Grade completed; pupils in boys' continuation school, Detroit, Mich.*

Grade completed.	Pupils in boys' continuation school, Detroit, Mich.		Grade completed.	Pupils in boys' continuation school, Detroit, Mich.	
	Number.	Per cent distribution.		Number.	Per cent distribution.
Total	618	100.0	First year high school	185	29.9
			Second year high school	28	4.5
Fifth grade	1	0.2	Third year high school	4	.6
Sixth grade	2	.3	Fourth year high school	4	.6
Seventh grade	248	40.1	Not reported	2	.3
Eighth grade	144	23.3			

According to Table 23 more than half of the 541 boys in the Detroit continuation school for whom information regarding industry and occupation was secured were engaged in the occupations classified by the United States Census of Manufactures as clerical—i. e., messenger boys, errand boys, office boys, parcel boys, and others. But 99, nearly one-fifth, were in occupations classified under iron and steel and other metal manufacturing. With regard to the type of establishment in which the occupation, whether clerical, mechanical, or otherwise, was performed, it was found that about two-fifths of the boys (248) were at work in metal-manufacturing establishments and over half of these (133) in factories producing automobiles or automobile parts. Among the pupils who, according to their continuation-school records, had made any decision as to the vocation they wished to follow (only about a fourth of those in attendance) a larger proportion had expressed a desire for work of the type found in metal manufacturing than for any other kind. Nearly one-third had said that they wanted to do machine work or some other mechanical work, a fifth that they wished to be toolmakers, and most of the others had expressed a desire for drafting, electrical engineering, pattern making, printing, or commercial work.

TABLE 23.—*Wage per week by occupation and industry; pupils in boys' continuation school, Detroit, Mich.*

Occupation and industry.	Pupils in boys' continuation school, Detroit, Mich.							
	Total.	Wage per week.						
		Total reporting	$3, less than $10.	$10, less than $15.	$15, less than $20.	$20, less than $25.	$25, less than $30.	$30 and over.
Total	618	504	23	249	161	47	18	6
Manufacturing and mechanical	163	125	4	32	59	20	5	5
Iron and steel and other metal	99	70	2	15	30	16	3	4
Apprentices	7	3	.....	1	1	1	.....	.....
Inspectors	7	4	.....	1	2	1	.....	.....
Machine operators	9	8	.....	1	6	1	.....	.....
Other occupations	76	55	2	12	21	13	3	4
Helpers	29	22	1	4	8	5	2	2
Bench hands	7	4	.....	.....	3	1	.....	.....
Miscellaneous	40	29	1	8	10	7	1	2
Lumber and its manufacture	18	17	1	4	9	1	2	.....
Printing and publishing	13	12	1	5	5	1	.....	.....
All other manufacturing	33	26	.....	8	15	2	.....	1
Transportation	24	22	1	4	13	2	2	.....
Messenger boys (telegraph)	17	15	.....	4	10	1	.....	.....
Other	7	7	1	.....	3	1	2	.....
Trade	35	34	2	10	16	2	3	1
Clerks (retail stores)	28	27	1	8	13	1	3	1
Other	7	7	1	2	3	1	.....	.....
Professional service	11	5	.....	5	.....	.....	.....	.....
Blue-print boys	9	4	.....	4	.....	.....	.....	.....
Apprentices (blue print)	1	1	.....	1	.....	.....	.....	.....
Tool designers	1	.....	.....	.....	.....	.....	.....	.....
Domestic and personal service	6	6	.....	2	2	.....	2	.....
Clerical	302	269	12	178	58	18	3	.....
Messenger boys	90	82	3	60	16	2	1	.....
Office boys	39	37	1	27	8	1	.....	.....
Errand, runner, and jumper boys	57	50	4	36	5	4	1	.....
Wrapper and parcel boys	13	12	.....	6	6	.....	.....	.....
Delivery boys	12	12	1	8	3	.....	.....	.....
Stock and tool boys	34	26	1	10	7	7	1	.....
Shipping clerks	8	8	.....	6	1	1	.....	.....
Other	49	42	2	25	12	3	.....	.....
Not reported	77	43	4	18	13	5	3	.....

The weekly wages of the boys attending continuation school—a group composed almost exclusively of the younger workers—were much lower, even among those employed in the metal industries, than the earnings of the minors included in the survey.[85] As shown by Table 23, over half of those reporting wages per week were earning less than $15. However, 14 per cent—nearly 1 in 7—were receiving $20 or more. Of the 60 for whom hourly wages were reported 10 were receiving between 20 and 30 cents an hour, 25 between 30 and 40 cents, and 25, 40 cents or over. The highest wages were generally found in the manufacturing and mechanical occupation group;[86] the lowest were those earned by messengers, office boys, and other clerical workers. The better opportunities for young workers in the technical occupations [86] in metal and other

[85] See p. 12 et seq.

[86] In the classification here used, which is that used by the U. S. Census, "manufacturing and mechanical" occupations include only occupations peculiar to the industry—not messengers, stock and tool-room workers, and other occupations classified under "clerical."

manufacturing industries were thus evident even very early in the boys' working lives.

Girls' continuation school.—Work in the girls' continuation school, unlike that in the boys', showed no connection with the metal-manufacturing industries. No courses training for metal-factory work were offered. The number of girls enrolled at the time of the study was 601; the total enrollment for the school year 1919–20 was estimated at about 1,400. About seven-eighths of the girls were under 16 years of age.

Night schools.

The night schools were open to all persons who were not required by law to attend day or continuation school, and an analysis of the records shows that men and women of all ages and nationalities took advantage of the opportunities offered. The total enrollment for the year 1919–20 was about 5,000. The data here presented were secured from the records of the first 500 pupils, taken alphabetically. Table 24 shows that of these pupils about one-tenth were women. Only a third were under 21 years of age, a slightly larger proportion of the men than of the women being in this age group. In contrast to the continuation-school pupils, none of the selected group were under 16 years of age. About one-third were foreign born; 15 per cent were from eastern or southeastern Europe, 12 per cent from northern and northwestern Europe, and 7 per cent from other countries. Of the whole group, 9 per cent were from Canada or Great Britain.[87]

Nearly three-fourths of the men and boys were engaged in the occupations classified as "manufacturing and mechanical," and by far the largest group, constituting 59 per cent of all the male pupils, were at work in metal manufacturing. The proportion of minor pupils who were in this industry was about the same as that of adults, but more minors proportionately were apprentices and fewer were machinists, inspectors, and grinders. None of the girls were employed in the metal trades—nearly all were nurses, stenographers, typists, or clerks.

[87] Figures on nativity were secured from a tabulation of 2,820 pupils, a group typical of the entire enrollment in evening high schools, made by the Board of Education of Detroit in 1921.

TABLE 24.—*Occupation and industry, by age and sex; selected group in night schools, Detroit, Mich.*

Occupation and industry and sex.	Pupils in selected group in night schools, Detroit, Mich.											
	Total.	Age.										
		Under 21 years.						21 years, under 25.	25 years, under 30.	30 years, under 40.	40 years, and over	Not reported.
		Total.	16 years, under 17.	17 years, under 18.	18 years, under 19.	19 years, under 20.	20 years, under 21.					
Male	449	146	8	26	37	39	36	130	95	65	8	5
Manufacturing and mechanical	332	103	5	13	33	31	21	91	76	53	7	2
Iron and steel and other metal	265	87	5	10	29	26	17	74	54	41	7	2
Apprentices	18	14	.....	3	5	3	3	3	1	.....	.....	.....
Grinders and polishers	11	1	1	.....	.....	.....	.....	2	4	4	.....	.....
Grinders	10	.....	.....	.....	.....	.....	.....	2	4	4	.....	.....
Polishers	1	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
Machinists, millwrights, toolmakers	85	25	.....	2	8	9	6	21	23	10	4	2
Machinists	38	9	.....	1	2	4	2	11	12	5	.....	1
Tool and die makers	25	9	.....	.....	5	2	2	6	6	.....	3	1
Other [1]	22	7	.....	1	1	3	2	4	5	5	1	.....
Mechanics	10	4	.....	.....	2	1	1	3	1	1	1	.....
Tinsmiths and coppersmiths	12	6	.....	1	2	2	1	.....	4	2	.....	.....
Other occupations	129	37	4	4	12	11	6	45	21	24	2	.....
Machine operators and machine hands	49	16	.....	2	3	8	3	16	8	9	.....	.....
Inspectors	20	1	.....	.....	.....	.....	1	11	3	5	.....	.....
Assemblers	21	7	.....	.....	6	1	.....	6	5	1	2	.....
Other iron and steel	39	13	4	2	3	2	2	12	5	9	.....	.....
Building trades	11	3	.....	1	1	.....	1	2	2	4	.....	.....
Electricians	37	7	.....	.....	1	4	2	11	13	6	.....	.....
Other manufacturing	19	6	.....	2	2	1	1	4	7	2	.....	.....
Transportation	22	9	.....	.....	2	2	5	8	3	1	1	.....
Telephone	17	8	.....	.....	2	2	4	6	2	1	.....	.....
Other	5	1	.....	.....	.....	.....	1	2	1	.....	1	.....
Professional service	27	6	.....	2	.....	1	3	15	2	2	.....	2
Draftsmen and designers	17	4	.....	1	.....	1	2	9	2	1	.....	1
Other	10	2	.....	1	.....	.....	1	6	.....	1	.....	1
Clerical	50	25	3	10	2	5	5	10	10	5	.....	.....
Tool and stock	9	6	.....	3	1	2	.....	1	1	1	.....	.....
Other	41	19	3	7	1	3	5	9	9	4	.....	.....
Other industries [2]	16	2	.....	1	.....	.....	1	5	4	4	.....	1
Not reported	2	1	.....	.....	.....	.....	1	1	.....	.....	.....	.....
Female	51	15	.....	3	2	5	5	21	12	1	.....	2
Professional service	26	8	.....	1	1	2	4	11	7	.....	.....	.....
Nurses	23	7	.....	.....	1	2	4	10	6	.....	.....	.....
Other	3	1	.....	1	.....	.....	.....	1	1	.....	.....	.....
Clerical	21	6	.....	2	1	2	1	9	3	1	.....	2
Stenographers and typists	14	5	.....	2	1	1	1	7	1	1	.....	.....
Other	7	1	.....	.....	.....	1	.....	2	2	.....	.....	2
Other industries	3	.....	.....	.....	.....	.....	.....	1	2	.....	.....	.....
Not employed	1	1	.....	.....	.....	1	.....	.....	.....	.....	.....	.....

[1] Includes 3 pattern-makers.
[2] Includes: Trade, 7; domestic and personal service, 5; public service, 2; agriculture, forestry, and animal husbandry, 2.

The general education of the night-school pupils, as is shown by Table 25, averaged somewhat higher than was found for the minors in the metal-trades survey. Seventy-three per cent of the former, as compared with 67 per cent of the latter, had completed the eighth or a higher grade; and 45 per cent, instead of 30 per cent, had had some high-school or college work. This is in accordance with the tendency, also found among the minors included in the factory survey, for those from the higher grades to seek further technical training.

The large majority of the men and boys were taking courses in some way related to metal trades.[88] The greatest number were enrolled in mathematics. Next in importance was the machine-shop course; then mechanical drawing, automobile, and electric courses. None of the women, on the other hand, were taking metal-trades courses.

TABLE 25.—*Previous education; selected group in night schools, Detroit, Mich.*

Previous education.	Pupils in selected group in night schools, Detroit, Mich.		Previous education.	Pupils in selected group in night schools, Detroit Mich.	
	Number.	Per cent distribution.		Number.	Per cent distribution.
Total	500	100.0	Eighth grade	139	27.8
			1, 2, or 3 years in high school	120	24.0
Third and lower grades	9	1.8	Graduate of high school	78	15.6
Fourth grade	12	2.4	1, 2, or 3 years in college	20	4.0
Fifth grade	6	1.2	College graduate	6	1.2
Sixth grade	22	4.4	Not classified	12	2.4
Seventh grade	37	7.4	Not reported	39	7.8

OTHER CITIES.

In Lansing 110 boys were enrolled in the 4-year industrial course given by the high school. During the last 3 years of the course they worked alternate weeks in the school and factory. The night school offered work in mechanical drawing, tool design, architectural drawing, sheet-metal drafting, shop mathematics, shop layout of castings and forgings, and electrical work; 310 pupils, most of them over 21 years of age, were enrolled in night industrial courses during the year.

The Saginaw High School (East Side) had a regular 4-year vocational course in which 104 pupils were enrolled. The work included mechanical drawing, shop mathematics, forging, machine-shop, and automobile courses. Cooperative part-time courses were furnished for a few pupils who were obliged to work or for some reason could not attend school full time. Two of the pupils were men working on night shifts who took machine-shop courses. In the night

[88] See General Table XVI.

school during the year there had been 30 enrolled in the class for mechanical drawing, from 14 to 18 in the pattern-making class, and from 14 to 16 in each of the three machine-shop classes. Most of the night-school pupils were above school age.

The Arthur Hill Trade School in Saginaw (West Side) offered four different kinds of classes: (1) The all-day industrial school, in which there were 67 boys and 57 girls. Enrollment in the courses dealing with metal work was as follows: Electrical, 23; machinist, 22; pattern making, 14; mechanical drawing, 12; motor mechanics, 13. (2) The part-time industrial school, in which were enrolled 39 boys, all over 16 years of age, who worked alternate weeks in school and factory. The school officials secured the factory jobs for the pupils and fixed the wage to be received at 25 cents an hour. Besides work at their trade these boys took mathematics, mechanical drawing, English, and citizenship. (3) The part-time continuation school, where pupils might take any kind of shopwork, and in which 3 women and 22 men, most of them men over middle age who were taking some special kind of shopwork, were enrolled. (4) The evening industrial school, with an enrollment for the year of 210 (170 men and 40 women); the numbers enrolled in metal-trade courses were as follows: Motor mechanics, 53; machine shop, 44; drafting, 26; electrical, 23; shop mathematics, 24. Pupils in trade extension courses under the Smith-Hughes law were required to be actually employed in the line of work for which the course was given. The ages of pupils in the evening school ranged from 18 to 60, averaging about 35.

The industrial courses offered in Bay City were woodworking and mechanical drawing. The night school for the year 1919–20 had a total enrollment of about 300, two-thirds of them men from 17 to 30 years of age. The three classes in mechanical drawing had an enrollment of about 16 each.

The Flint public schools offered courses in mechanical drawing, pattern making, and electrical wiring. The Industrial Fellowship League, made up of all the factory workers of the city, offered extensive industrial training in its evening and afternoon classes, including automotive courses, drawing and design, shop mathematics, electrical courses, metallurgical courses, and machine-shop courses.

INDUSTRIAL ACCIDENTS TO MINORS, SAFETY CONDITIONS, AND ACCIDENT PREVENTION.

LEGAL PROTECTIVE MEASURES.

The analysis of occupations in which minors are engaged, made in connection with this study,[89] though it did not attempt to cover the accident hazards in every detail, showed clearly that many of these young persons were at work in dangerous surroundings. Moreover, the tendency of modern legislation to protect the immature worker from the hazards to which adults are exposed indicates that in any survey of a highly complicated machine industry such as that of metal manufacturing, it is necessary to consider accident risks and methods of accident prevention.

Under the workmen's compensation law of Michigan [90] in effect at the time of this study, compensation was provided for industrial accidents resulting in injury or death. Election to come under the act was optional with the employer, but if he did not do so he was left, in case of injury to an employee, to face a suit for damages with the usual common-law defenses [91] removed. If the employer's negligence could be proved, the assessment of damages by the jury would follow as a matter of course. All the employers included in this survey had accepted the act. Reports of all accidents were required to be sent to the industrial accident board, which administers the law.

The State child labor law prohibited the employment of boys under 18 and girls under 21 in "any hazardous employment," specifying "cleaning machinery in motion" and giving to the State department of labor authority to determine what other employment should be regarded as hazardous.[92] Although it has not been the practice of the department to make general rulings as to dangerous occupations, decisions have been made as to whether minors might be employed on specific machines in individual plants. Since minors illegally employed were not covered by the compensation act, recovery, in case of injury to such a minor, was at common law, except that the employer, just as when he refused to come under the act, was denied the defenses of assumption of risk by employee, fellow servant, and contributory negligence. Moreover, the fact of employment con-

[89] See p. 63 et seq.

[90] Michigan, Acts of 1912, First Extra Session, No. 10, as amended by acts of 1913, Nos. 50, 156, acts of 1915, Nos. 104, 153, 170, 171, and acts of 1917, Nos. 41, 206, 235, 249.

[91] Assumption of risk, fellow servant, and contributory negligence.

[92] Michigan, Howell's Annotated Statutes 1913, sec. 4019, as amended by Acts of 1915, No. 255.

trary to the statute constituted in itself actionable negligence. This increased the risk of having to pay heavy damages, and served to a certain extent as a check upon employment of minors of the prohibited ages at any kind of work likely to result in accident, whether or not specifically named as "hazardous" by the law or by the department of labor.

STATE RECORDS OF INDUSTRIAL ACCIDENTS TO MINORS.

Statistics that would make it possible to measure accurately the risk to which minors are exposed in the different industries are not available for the State as a whole. For a scientific analysis of the accident situation as it involves minors, it is necessary to know the accident severity and frequency rates [93] by age and by occupation, and the occupation classification used must take into account the industry and the production department, as well as the specific occupation. Though information of this kind might have been secured from individual factories, it was not possible in connection with the present study to attempt a collection and analysis of these data. The only practicable sources of material were the records of the Michigan Industrial Accident Board, which give the age of the injured employee and use the standard classifications [94] in describing industry, cause of accident, location of injury, and extent of disability. The records selected for study include all accidents to workers under 21 years of age occurring in the State in the year 1918 [95] which arose out of or in the course of employment and which resulted in death, dismemberment, or in incapacity for work lasting at least 15 days.[96] This study was not confined to metal-working industries, but, for purposes of comparison, included all industrial accidents. The tables are arranged to show separately as far as possible accidents occurring to minors engaged in the type of occupations included in the factory survey.

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[93] For the standard method of computing these rates, see Chaney, Lucian W.: Accidents and Accident Prevention in Machine Building, ch. 1. U. S. Bureau of Labor Statistics Bulletin 256 (Revision of Bulletin 216). Washington, 1920.

[94] These classifications are found in the following report: Standardization of Industrial Accident Statistics: Reports of the Committee on Statistics and Compensation Insurance Cost of The International Association of Industrial Boards and Commissions, 1915–1919. U. S. Bureau of Labor Statistics Bulletin 276. Washington, 1920.

[95] This year was chosen in order to allow a sufficient lapse of time after the date on which the accident occurred to make possible a record of the extent of disability.

[96] Accidents causing disability lasting less than 15 days were not compensable. Since 1918 the law has been amended to compensate accidents resulting in disability of more than one week.

TABLE 26.—*Duration of absence from work by industry; minors injured in industrial accidents in Michigan, 1918.*

Industry.	Minors injured in industrial accidents in Michigan, 1918.								
	Total.	Fatal cases.	Cases involving loss of member.	Duration of absence from work.					
				15 days, less than 3 weeks.	3 weeks, less than 4.	4 weeks, less than 6.	6 weeks, less than 13.	13 weeks, less than 52.	Duration over 15 days, exact time not reported.
Total	1,905	28	238	330	359	472	379	69	30
Agriculture	5	.....	.....	.....	.....	.....	4	1	.....
Mining	221	8	5	61	37	54	41	14	1
Quarrying	5	1	.....	1	1	1	.....	1	.....
Manufacturing	1,463	13	223	229	291	364	281	39	23
Building and hand trades	33	1	2	5	10	5	9	1	.....
Chemicals and allied products	35	1	5	3	7	6	11	1	1
Food and kindred products	73	3	5	13	11	17	18	3	3
Metals	765	5	130	119	150	205	129	18	9
Automobile factories	129	.....	17	19	24	37	25	4	3
Automobile parts	188	2	31	28	28	57	33	5	4
Foundries	309	1	62	44	70	77	46	7	2
Ship and boat building	32	2	5	5	1	10	8	1	.....
Other	107	.....	15	23	27	24	17	1	.....
Lumber and its manufacture	286	1	34	47	62	70	56	11	5
Paper and paper products	64	1	13	12	13	13	10	1	1
Textiles	45	.....	6	9	13	9	7	1	.....
Other	162	1	28	21	25	39	41	3	4
Transportation	90	4	4	16	10	29	16	8	3
Trade	104	1	6	19	20	20	30	5	3
Service	16	1	.....	3	.....	4	7	1	.....
Not reported	1	.....	.....	1	.....	.....	.....	.....	.....

The records showed that 1,905 compensable accidents to minors had occurred during the selected period. The large majority (77 per cent) of these accidents occurred in the manufacturing industries, and in this group, according to Table 26, metal-working factories were responsible for over half. An analysis according to occupation rather than industry, found in Table 27, shows that 863 accidents (45 per cent of the total) were accidents to machine operators; of these, 56 per cent were accidents to operators of metal-working machines. When the cause of accident is considered, machinery is shown, in Table 28, to have been responsible for 984 accidents, or 52 per cent of the total number; and nearly all of these—45 per cent of the entire number of accidents—were caused by power-working machinery. In this power-machine group, metal-working machines caused 56 per cent of the accidents, and punch presses headed the list of specified types of machines, being responsible for a far larger number of accidents than any other machine.

TABLE 27.—*Occupation when injured, by age at time of accident; minors injured in industrial accidents in Michigan, 1918.*

Occupation when injured.	Minors injured in industrial accidents in Michigan, 1918.							
	Total.	Age at time of accident.						
		Under 16.	16 years, under 17.	17 years, under 18.	18 years, under 19.	19 years, under 20.	20 years, under 21.	Not reported.
Total	1,905	45	193	291	587	416	364	9
Machine operators	863	19	97	137	292	159	153	6
Metal working	481	3	32	74	162	98	107	5
Woodworking	192	9	40	34	62	25	21	1
Paper working	71	2	6	6	31	14	12	.....
Leather working	19	.....	3	3	8	2	3	.....
Textile and laundry	35	1	9	8	7	6	4	.....
Food products	27	2	4	3	7	6	5	.....
Stone, clay, and glass	1	.....	.....	1	.....	.....	.....	.....
Not reported	37	2	3	8	15	8	1	.....
Factory workers, not machine operators	363	12	40	56	107	77	70	1
Machinist, mechanic, repairman	60	.....	2	6	19	15	18	.....
Transportation	185	3	15	27	54	54	30	2
Miners	163	.....	13	21	40	45	44	.....
Lumbermen	57	1	2	8	21	13	12	.....
Hand and building trades	54	.....	4	10	12	13	15	.....
All other	160	10	20	26	42	40	22	.....

TABLE 28.—*Age at time of accident, by cause of accident; minors injured in industrial accidents in Michigan, 1918.*

Cause of accident.	Minors injured in industrial accidents in Michigan, 1918.							
	Total.	Age at time of accident.						
		Under 16.	16 years, under 17.	17 years, under 18.	18 years, under 19.	19 years, under 20.	20 years, under 21.	Not reported.
Total	1,905	45	193	291	587	416	364	9
Animals	10	.....	.....	1	4	1	3	1
Hand tools	89	3	6	13	28	21	18	.....
Objects being handled	257	4	20	36	83	64	49	1
Falling objects	96	1	8	15	25	20	27	.....
Stepping on or striking against objects	32	.....	5	6	6	9	6	.....
Fall of persons	103	.....	14	16	26	27	20	.....
Explosives, electricity, hot substances	89	1	5	12	20	24	27	.....
Vehicles	224	6	26	30	61	66	34	1
Boilers and steam-pressure apparatus	4	.....	.....	1	.....	1	2	.....
Machinery	984	30	107	158	334	178	171	6
Prime movers	20	.....	1	3	4	9	3	.....
Hoisting apparatus, and conveyors	60	4	9	5	21	13	8	.....
Power-transmission apparatus	54	3	7	8	21	5	10	.....
Power-working machines	850	23	90	142	288	151	150	6
Metal working	480	4	31	74	162	101	103	5
Abrasive	50	.....	2	11	13	11	13	.....
Drills	46	2	1	4	17	10	12	.....
Lathes	29	.....	2	2	10	6	9	.....
Milling machines	39	.....	3	10	14	4	8	.....
Punch presses	85	.....	6	11	32	14	19	3
Presses (n. o. s.)	85	1	7	10	26	27	14	.....
Other	146	1	10	26	50	29	28	2
Wood working	202	12	37	41	64	24	23	1
Paper working	66	2	6	7	28	10	13	.....
Leather working	19	.....	2	2	8	3	4	.....
Textile and laundry working	29	1	7	7	7	5	2	.....
Food products	20	2	4	3	5	3	3	.....
Stone, clay, and glass working	1	.....	.....	1	.....	.....	.....	.....
Power working (n. o. s.)	33	2	3	7	14	5	2	.....
Miscellaneous specified causes	8	.....	1	2	.....	2	3	.....
Not reported	9	.....	1	1	.....	3	4	.....

A larger number of accidents occurred to minors who were between the ages of 18 and 19 than to those in any other year of age, the number of accidents to the 19-year-old group decreasing 29 per cent, and the number to the 20-year-old group decreasing 38 per cent, from the number which occurred to the 18-year-old group. While figures are not available for the total numbers employed at each of these ages, these findings, in view of the great probability that the number employed increases with each year of age,[97] indicate a smaller accident rate for the older minors.

Of the total accidents 28 resulted fatally,[98] leaving 1,877 nonfatal cases; of these, 238 involved dismemberment, and the balance (1,639) incapacity for work for from 15 days to 1 year.

SAFETY CONDITIONS AND ACCIDENT PREVENTION IN THE FACTORIES SURVEYED.

Whether or not the accident risk to minors in metal-manufacturing industries is greater than for adults, the mere number of serious accidents shown for a single year gives evidence of the need for considering accident hazard and prevention in any appraisal of conditions affecting minors in these industries.

Since 1909, when a State department of labor was created in Michigan[99] with authority to collect and systematize information as to the number and character of industrial accidents, public and private organizations with varying points of views have joined forces in working for accident prevention throughout the State. But, though Federal and State labor departments, vocational-education bureaus, industrial-accident boards and commissions, insurance companies and workmen's compensation bureaus have acted as spurs to the safety movement, it is the plant-safety department as an integral part of factory organization which must chiefly be depended upon to reduce industrial-accident hazards.

Factory safety organization.

According to the United States Bureau of Labor Statistics,[1] a good factory safety organization should measure up to the following standards: "(1) Safeguarding by signs, warnings, and mechanical contrivances; (2) adequate safety inspection; (3) safety committees of superintendents, foreman, and workmen; (4) emergency and hospital care of the injured; (5) a compensation or relief system."[2]

[97] Though enlistments may have reduced somewhat the number of minors at work at the ages of 19 and 20, this would probably not account for the decrease in number of accidents.

[98] See Table 26.

[99] Michigan, Acts of 1909, Act No. 285.

[1] Chaney, Lucian W.: Accidents and Accident Prevention in Machine Building, p. 41. U. S. Bureau of Labor Statistics Bulletin No. 256.

[2] The State compensation law is discussed on p. 48.

In addition to these five points might be mentioned another, namely, the compilation and analysis of plant-accident figures.

Safeguarding by signs, warnings, and mechanical contrivances.—Six of the 19 factories from which information on this point was secured were doing excellent work in safeguarding by signs, warnings, and mechanical devices. Four of these were automobile factories, one made automobile parts, and the sixth was a large machine shop. Each employed a full-time safety engineer whose duty it was to study accident causes and to work out methods of prevention, and who kept careful watch of the condition of machinery and machine guards, of passageways and piled material, and of the way in which employees carried out the rules of the safety department. These safety engineers attempted to interest employees in accident prevention and to emphasize the need for considering safety before profit in production.

In one of these plants the safety department was 7 years old. The chief, a machinist with 11 years' experience as a safety engineer, had 4 assistants, all practical men. In addition, 8 sheet-metal men and 3 pipe fitters were employed to make safeguards at his direction. Frequently changed safety bulletins and careful instruction of men on new jobs were among the methods used by this firm to interest employees in accident prevention. One man from the safety department worked full time in the punch-press department instructing workers, as that machine is considered difficult to make accident-proof.

In discussing machine accidents, one safety man said: "Although safe machines have been worked for incessantly, machine accidents are still too numerous. It is possible to guard a machine so that it will be safe for the constantly careful operator, but it is hard to provide safety devices which can not be removed and which guard against the involuntary movement."

Among the effective plans which had been worked out to further an interest among employees in personal safety were the following: General rules for plant safety and safe machine operating posted throughout the factory; a box labeled "Safety Suggestions," with prizes for those which could be used; a bonus offered to the department having the lowest accident rate, at regular intervals; individual prizes for employees who had worked a certain length of time without accident; the discharge of men who disobeyed the safety rules; and encouragement of safety discussion among employees.

In one factory the safety man distributed to the machine operators cards showing the hazard incident to the operation of each machine and rules for safe operation. For instance, he would give a drill-press card to a drill-press operator, have him sign his name on half the card, tear off the name for the safety-department file and leave

the rules and the statement of hazards with the operator, who thus was made to feel responsible for safe operating. Careful instruction of men on new jobs and talks with individual operators seemed to be the most practical safeguarding methods.

In seven of the smaller factories a safety committee made up of men who had other work in the factory did accident-prevention work, keeping track of machinery in their various departments, making suggestions at committee meetings, and posting bulletins. In the six remaining factories surveyed, foremen or machinists were responsible for the safeguarding of employees.

Safety inspection.—In the six plants employing safety engineers the factory was constantly under inspection. In one establishment every part of the plant was inspected daily, and an inspector was employed by the company to check up on the safety department. He came once a month, spending three days in going over the entire plant. The safety engineer and his assistants encouraged reports from members of the shop safety committees concerning machines and transmission machinery which could be guarded more effectively, defective machinery, defective safeguards, dangerous placing of material, and disregard of safety rules. In the plants having only the committee form of safety organization, committee foremen or members of the committee reported unsafe practices or conditions to the committee for action. In the remaining establishments the foremen were responsible for inspection.

Safety committees.—Safety engineers of experience stated that safety committees made up of superintendents, foremen, and workmen were a potent force in prevention work, since each in his individual field is vitally interested in "getting safety results." In one large machine shop the safety engineer had organized (1) a general committee consisting of himself, the chief engineer, the superintendent of the boiler shop, and the assistant superintendent of the plant; (2) a shopmen's committee of six employees chosen for efficient workmanship; (3) a foremen's committee of six. These committees met monthly to discuss ways and means of doing away with dangerous conditions and practices. Three of the other factories had much the same plan of committee organization. Eight of the remaining 15 factories had committees made up of superintendents and foremen but no workmen, and 7 did not have safety committees.

Emergency and hospital care.—Considerable differences in the provision made for medical care of injured employees existed among the different plants. In a factory at one end of the scale the manager called upon "a fellow from one of the departments who was handy at bandaging" in case of slight injuries; and when a "juicy" one occurred, he himself took a "look at it," one of his ancestors having been a doctor. On the other hand, in three of the larger factories

one or more physicians were employed full time, and all but three plants had at least a room equipped for first-aid treatment. In all but six full-time trained nurses were in attendance. Since medical aid and hospital care were easily accessible to the factories studied, a well-equipped first-aid room and a trained nurse in the factory were sufficient to insure adequate care.

Plant physicians were of the opinion that sickness no less than accidents is an important item in calculating lost time, and that reducing the sickness rate is as necessary to efficiency as preventing accidents, though not as spectacular. In addition to their work of attending injuries, reducing absence from work on account of accidents to a minimum, and investigating possibilities of occupational disease, they made physical examinations of applicants, rejecting those who had certain infectious diseases; they kept a careful watch on general factory sanitation with a view to possible improvement; and they sometimes even went outside the factory to investigate conditions—for instance, those relating to water and food—which might give rise to epidemics or disease in the factory community.

Plant-accident figures.—None of the factories had compiled frequency or severity rates according to exposure to risk. In the factories having a safety engineer the safety-office files showed in tabular and graphic form the accidents per 100 employees; the accident cost per employee by departments; and the number of cases per month by cause of accident, nature of injury, location of injury, and number of hours lost. In addition, the safety engineer made an estimate of the cost of accidents per month, including compensation paid, medical service rendered, and time lost breaking in a new man or waiting for the injured employee, because the company was interested in these facts and because they tended to show that his safety department paid.

One such department made monthly reports with tables giving causes of accident, nature and location of injury, and number of lost-time accidents per 1,000 workers. The following figures from one of these tables show a decrease, indicating the efficiency of the department:

	Jan., 1917.	Apr., 1920.
Total employees	12,707	22,276
Total accidents	1,156	1,121
Lost-time accidents	99	92
Accidents per 1,000 employees	90.9	50.5
Lost-time accidents per 1,000 employees	7.8	4.1

One of the safety men reported that he had not been interested in detailed occupational rates because he aims "to reduce accidents to as near zero as they will go," and if even one accident occurs on a milling machine, for instance, he immediately works to prevent a repetition.

In the factories having no full-time safety engineer the records kept merely complied with the requirements of their insurance companies and of the industrial accident board, which did not necessitate compilation or analysis, but which included specific information in regard to each accident.

State prevention work.

On an accurate analysis of the real cause of accident depends the creation of a safety zone which would allow minors to be useful industrially without submitting them to undue risk of injury. A classification of the cause of accident according to the standard list [3] shows, it is true, the immediate reason. But to know that 257 minors were injured by "objects being handled," or 54 by getting into "power-transmission apparatus," or 85 by tripping a punch press at the wrong time, is merely a beginning. Scientific preventive work demands the fixing of ultimate responsibility. Was carelessness the reason, or negligence, or was it the fault of a fellow employee, or lack of skill and coordination due to inexperience, or lack of proper initial instruction, or defective machinery? Or did it happen that some disturbance interrupted the rythmical sequence of the motions of the operator, and that before he was able to recover his poise an accident occurred?

At the time of this study the Michigan State Department of Labor [4] collected and published annually statistics relating to hours of labor and number, age, and sex of employees, and did safety work by inspecting establishments for unsafe practices. Under the recent reorganization by which the department of labor and the industrial accident board are combined in the department of labor and industry,[5] it should be possible to make an analysis which would throw light on the problems suggested above. If the records now in hand could be supplemented by the material necessary to compile accident severity and frequency rates on the basis of age and according to a uniform classification of occupations, it would make possible a valuable interchange of accident-prevention experience. Such a study would also enable safety experts to compile a list of occupations involving a risk on the part of the young worker or a menace to his health.

Moreover, work for the prevention of accidents, however valuable, should be supplemented by efforts looking toward the elimination of minors, at least those in the younger age groups, from occupations admittedly hazardous.

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[3] See p. 49.

[4] See p. 52.

[5] Michigan, Acts of 1921, No. 43. This law, which became effective July 1, 1921, created the department of labor and industry and transferred to it the powers and duties of the organizations mentioned above and in addition those of the board of boiler rules and the industrial relations commission.

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PLATE VIII.—MACHINE SHOP. AT LEFT, ROUGH HAND GRINDING; AT RIGHT, MILLING MACHINES.

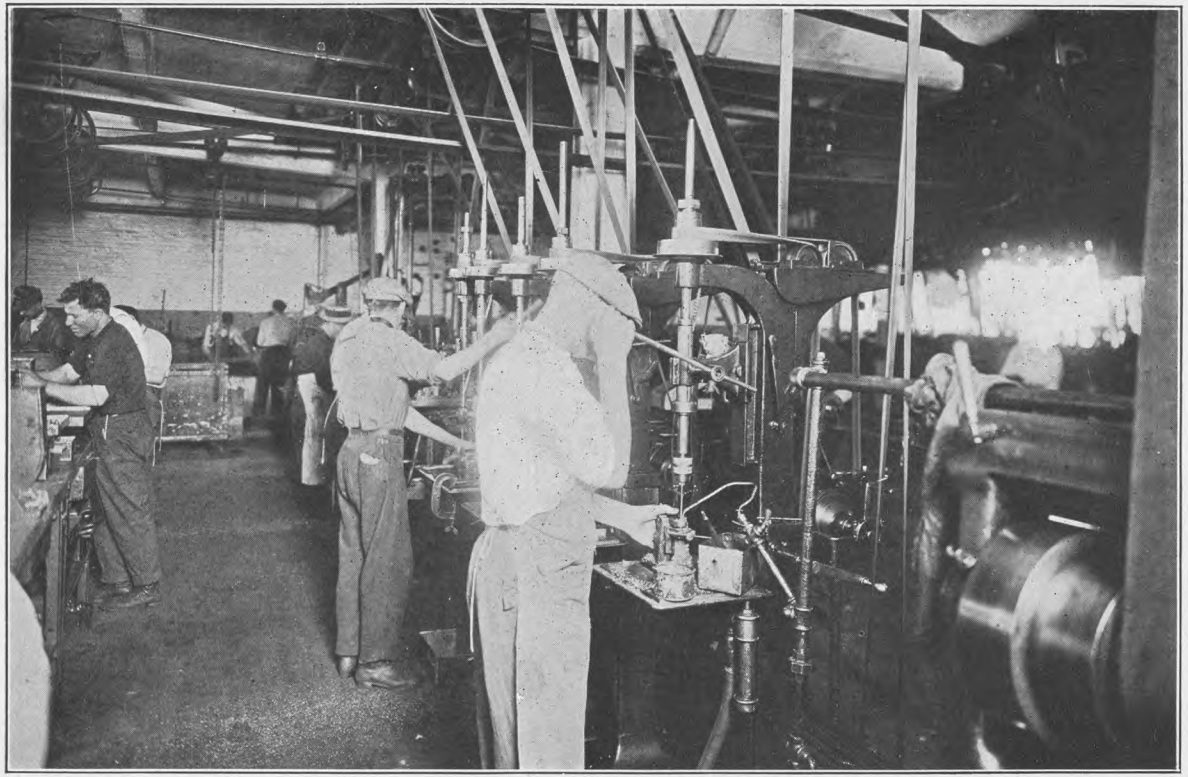

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PLATE IX.—SENSITIVE SPEED-DRILL PRESS.

SUMMARY AND CONCLUSIONS.

In the representative metal-manufacturing factories of Michigan included in this survey 11 per cent of all the employees were young persons under 21 years of age. Of these minors 99 per cent were over 16 years of age and about two-thirds were between 19 and 21. Nearly half the young workers of the questionnaire group reporting nativity were either foreign born or of foreign parentage, but about a third of this group belonged to English-speaking nationalities easily assimilated to the native population.

Minors were found engaged in nearly all kinds of work done in the factory, but they were most numerously employed as machine operators, laborers, and helpers, inspectors, stock and tool-crib workers, and assemblers—occupations requiring relatively little training and skill. A few were doing skilled work such as that of machinist or toolmaker or had jobs in which the experience gained would fit them directly for higher-grade work.

The boys outnumbered the girls eight to one. Most of the girls were working as inspectors, trimmers, assemblers of small parts, sewing-machine operators, stock and tool-crib workers, and core makers, but a few were employed as drill or milling-machine operators. Wages were lower for girls than for boys, even in the same occupations, and opportunities for promotion were fewer.

Promotion is open to boys in most occupations in the metal-working industries. Even for many of the better jobs, technical training other than that obtained through factory experience, though desirable, is not essential. While the comparatively small number of higher-paid and more responsible jobs makes it impossible for all those having the requisite training to secure the better positions, the increase in opportunities caused by the constant expansion of the industry helps to offset this disadvantage.

Fifteen per cent of the minors for whom information as to hours of work was secured had worked over 54 hours a week, certainly a long working week for young persons. (Hours of labor of boys over 18 are not restricted by law in Michigan.) Two per cent had been employed for more hours than the conservative legal standards for other minors.[6] To secure adequate protection of all working boys and girls not only should the present legal standards be strictly enforced, but further legislative restrictions should be placed upon the hours of all minors over 16 years of age. A short working

[6] See pp. 11 and 12.

week was reported by a considerable number of minors, but this was due rather to shifting from job to job than to curtailment of production.

Earnings were high, even taking into consideration the fact that the study was made during a period of exceptionally high wages. The median weekly earnings were $27, the median hourly earnings, 60 cents; nearly a fourth of the workers had earned $35 or over a week. Some of these had worked unusually long hours to receive the high pay, but, on the other hand, a fourth had worked only from 42 to 48 hours. Boys working as painters, trimmers, body assemblers, motor, final, and outfit assemblers, or sheet-metal workers received the highest median hourly earnings, while apprentices, oilers, straighteners, stock and tool-crib workers, and laborers and helpers received the lowest. Where the age of entering industry had been 16 years or over there was a constant increase of earning power with experience.

The study of the work histories of the minors employed showed that there had been a large amount of shifting from job to job, particularly in the first year or two of industrial life. The existence of much shifting at the time of the survey is indicated by the fact that a large number of minors failed to reply to the questionnaire because they had left their jobs in the short period while the records were being copied and the questionnaires prepared for distribution. In the nine factories from which turnover[7] for the whole plant could be secured it varied from 110 per cent in an automobile factory to 420 per cent in a large foundry. Employers might obviate some of this shifting by educational methods and by working out definite schemes of promotion.

Two-thirds of the minors had completed the eighth or a higher grade, and 30 per cent had taken high-school courses. While the proportion of minors with at least an eighth-grade education compares favorably with the proportion for the country as a whole, a comparison of grade completed and age at leaving school shows a surprisingly large amount of retardation—52 per cent. This may be accounted for at least in part by the comparatively high age standard of the Michigan compulsory education law, which kept many children in school until they were 15 or 16 years of age. Fifteen per cent of the boys had taken vocational or prevocational courses of value in the metal-working industries. Most employers gave preference to applicants with at least an eighth-grade education, and for occupations requiring some knowledge of mechanics or drafting they preferred boys with technical training. Technical or trade training of some kind was available in the public schools of all the cities visited. Few employers used the apprenticeship method to

[7] Turnover was found by dividing the total number of separations for the year by the average number of equivalent full-time workers for the year and multiplying the quotient by 100.

train beginners for the skilled trades. Most of the occupations in which minors were working were relatively unskilled jobs for which a few weeks' experience in the factory afforded all the training actually needed.

Better general and technical education appears to result in slightly higher wages even among workers under 21. This, together with the fact that trade training facilitates advancement to the more desirable jobs, makes it important to emphasize the value of both types of education to the boy who wishes to advance.

In the year 1918 there were 1,905 industrial accidents to minors, resulting in death, dismemberment, or incapacity for work lasting from 15 days to 1 year. A large number of these accidents occurred in the metal-working industries. Efforts toward accident prevention existed in all the factories visited, though in different states of development. In a few plants these efforts did not extend beyond compliance with the State accident board requirements as to the keeping of accident records, and a certain amount of inspection. At the other end of the scale were those plants which maintained a well-developed safety department, with an engineer and assistants whose business it was to inspect the factory for unsafe conditions, devise efficient machine guards, carry on a continuous educational safety campaign among workmen, and, above all, to make a minute study of accidents which occurred and take steps to prevent their repetition. The State records give cause of accident and extent of disability by age, but the lack of uniformity in reporting occupations makes it impossible to measure exposure to risk for minors as compared with that for adults. If the State accident board[7a] required employers to use a uniform classification of occupations and to report for each occupation the number of full-time workers employed, it would have in hand material for computing frequency and severity rates, an analysis of which is necessary for efficient prevention work.

The accurate and uniform naming of occupations on the factory records and their careful definition and analysis, which would be necessary in order to make reports according to such a uniform classification of occupations, are fundamental not only to the work of accident prevention, but also to adequate vocational training and guidance, and to intelligent issuance of employment certificates.

[7a] The powers of the State accident board were transferred in 1921 to the newly created department of labor and industry. See footnote 5, p. 56.

APPENDIXES

APPENDIX I.—DESCRIPTIVE ANALYSIS OF COMMON OCCUPATIONS OF MINORS.

Even this somewhat general survey of minors employed in the metal-manufacturing industries would lack completeness if it were not supplemented by descriptions of the kinds of work which they do. Teachers, vocational counselors, certificate-issuing officers, and other persons whose work is related to the transition of children from school to the various types of industry need to understand, at least in a general and untechnical way, the processes which the child will be called upon to perform. To obtain this knowledge is especially difficult for those without technical training or without the time and opportunity for personal investigation, because the comparatively simple types of work—in which minors are chiefly employed—have not been considered worthy of analysis by the technical writers on the subject.[1]

The limited scope of the survey made impracticable an exhaustive and technical study of the postural and other physical strains incident to each occupation or of the probable effects upon health and physical development of the work which these minors were doing. But it was felt that a careful description of the processes, attempting to emphasize the aspect of the work which made it difficult, hazardous, or mentally or physically trying would present such a picture of the young worker and his environment as would serve all practical purposes. The process studies were made and the descriptions written by a mechanical engineer familiar with the construction and operation of machines and with the technical work of metal manufacturing.[1a] The information in regard to the hazards incident to the occupations described was supplemented by data obtained from employers, safety engineers, and representatives of insurance companies carrying industrial accident risks, regarding general hazardous conditions and occupations in metal-manufacturing plants of the type studied and the dangers of the particular occupations in which minors were found engaged.

Because occupations designated as identical vary in detail with the type of product, the machine used, and the kind of establishment, it was necessary to select for each of these descriptions an individual process as carried on in a single factory. Nor was it possible, owing to limited space, to describe all the different kinds of work that

[1] See Appendix IV, Bibliography, p. 127, for references to technical works describing the more skilled occupations.

[1a] Later, the descriptions were read and criticized by officials, including superintendents and employment managers, in a number of the factories where the studies were made.

minors were found doing. But every effort has been made to select typical processes, and it is believed that these illustrations fairly represent the occupations of young persons in the factories studied.

The occupational descriptions were supplemented by information obtained from employment managers as to the general or technical education and the industrial experience needed for the type of operation described, as well as the time required for learning and becoming proficient in its performance. The occasional wide variations of opinion found were probably due less to actual differences in standards than to the fact that some occupations nominally identical in reality—owing to a difference in the tools used or in the nature of the product—required more training and skill in one factory than in another.

In order to show how each process relates to the work of the factory as a whole, the discussions of the specific occupations studied are arranged under the departments in which the workers are usually found. The departments are taken up as far as possible in an order corresponding to the factory organization for production, as follows: (1) Engineering department; (2) pattern shop; (3) foundry; (4) core room; (5) casting-cleaning department; (6) forge shop; (7) heat-treat department; (8) machine shop; (9) tool room; (10) sheet-metal department; (11) paint shop; (12) trimming and top-making departments; (13) inspection department; (14) assembly department; (15) testing, adjustment, and final-repair department; (16) other departments.

No one general outline, however, could be entirely accurate in detail for every plant, as production methods varied slightly in each one. None of the factories visited included all these departments, some because the product did not demand all types of work, others because certain of the parts used, such as forgings or castings, were purchased instead of manufactured.

THE ENGINEERING DEPARTMENT.

WORK DONE.—In the engineering department are designed all the products which are to be made in the factory, as well as any special tools, jigs, dies, or fixtures necessary to their production. Drawings and blue prints are made for the pattern shop, the machine shop, and any other department doing work on any part. In automobile-body factories and other factories producing parts on special contract, however, designs and working drawings of the parts ordered may be furnished by the purchaser. All experimental work of the factory is done here, and materials used in the factory are tested.

MINORS EMPLOYED.—In the factories studied 13 minors were employed as draftsmen and designers, 3 as chemists, a few in testing materials for use in the factory, and a few as blue-print machine

operators, blue-print boys, and messengers. Most of the work of the engineering department demands such a high grade of skill and experience that few workers under 21 years of age are employed. Its chief importance in this study lies in the fact that many boys engaged in other work in the factory hope for promotion to other positions in this department as tool designers or draftsmen.

Tool designer and tool detailer.[2]

Description of work.—The tool designer designs and makes working drawings for special tools, jigs, and fixtures, such as screws, turret-lathe fixtures, milling-machine tools, boring bars, and stamping, forming, and drawing dies. The detailer draws in detail from the general drawing the parts of any given machine.

Hazards or strains.—The work involves eyestrain, the exercise of a high degree of accuracy and responsibility, and the usual physical disadvantages of an exacting sedentary occupation. There is no accident hazard.

Requirements.—Thorough training in all drafting methods and conventions and in the accurate use of the T square, triangle, scale, protractor, and other drawing instruments, as well as experience as operators on the types of machines for which they are to design tools, are necessary for both designers and detailers. They must have a working knowledge of mathematics, mechanics, the strength of materials, and the relation of the views of mechanical drawings, and be able to make calculations and layouts and developments for sheet-metal work. They must be familiar with the common stock materials (such as bolts, nuts, washers, common sizes of stock iron and steel rods and bars), the standard types and sizes of drills, taps, dies, reamers, and gear cutters, know the meaning of the common shop terms (such as drill, ream, tap, bore, grind, taper, face, finish, etc.), know the use of reference books and catalogues, the principles of pattern making and molding, and the pattern-shop and foundry notations. The work of the detailer requires less responsibility and originality than that of the designer.

Tool designers must be at least 18 years of age. The employers interviewed preferred boys with experience as draftsmen, toolmakers, or machine hands.

Learning period (tool designer).—Two and a half to four years; from three to six years to become proficient.

Assistant chemist.

Description of work.—The chemist in one of the automobile factories visited tested the chemical properties of samples of all materials used in the factory. The assistant chemist usually worked

[2] For earnings, see Table 7, p. 16, where these occupations are classified under draftsmen and designers.

with him, but on many occasions he had to work alone and take the sole responsibility of the test. Following is a partial list of the materials tested: Steel for phosphorus, sulphur, manganese, and carbon; alloy steel for chromium, nickel, vanadium, and tungsten; high-speed steel for tungsten; cast iron for sulphur, phosphorus, silicon, manganese, and carbon; iron and steel for hardness, by means of the scleroscope and the Brinell hardness machine; brass, bronze, babbitt, aluminum, and German silver for copper, lead, zinc, tin, antimony, magnesium, and aluminum; phosphorus bronze for phosphorus and manganese; paints, varnishes, and resins for oil content, kind of oil, pigment, and drier; lubricating oils and greases for flash point, burning, viscosity, per cent emulsion, and per cent ash; cutting compounds and cutting oils for per cent mineral and per cent vegetable oil.

Hazards or strains.—Slight burns and minor explosions in handling chemicals. Nervous strain due to responsibility, accuracy, and sometimes speed in doing work.

Requirements.—Courses in chemistry or engineering are usually required, though in some cases the necessary experience may be obtained in the factory.

Learning period.—For chemist whose work is described above, two years; a longer period to become proficient.

Scleroscope operator.

Description of work.—The testing of materials may be subdivided into several comparatively simple operations, one of which is the determination of the relative hardness of metals, by testing with a scleroscope. This instrument consists of a glass tube about a foot long and with an inside diameter of about one-fourth of an inch, in which is a small steel hammer tipped with diamond and controlled by a rubber bulb attached by rubber tubing to the top of the glass cylinder. The operator places the piece to be tested under the base of the scleroscope and lowers the glass tube until it rests upon this piece. He then squeezes the bulb and the hammer drops; as it hits the hardened surface it rebounds. The operator reads the height of the rebound as indicated on the graduated scale which is on or behind the glass tube and records it. He must read the scale very quickly and accurately at the moment the hammer reaches the height of its rebound.

Hazards or strains.—Little danger is inherent in the occupation. There may be physical strain due to handling heavy material.

Requirements.—No technical education is necessary. Experience in the factory as assembler or machine operator is desirable.

Learning period.—Two weeks; six weeks to become proficient.

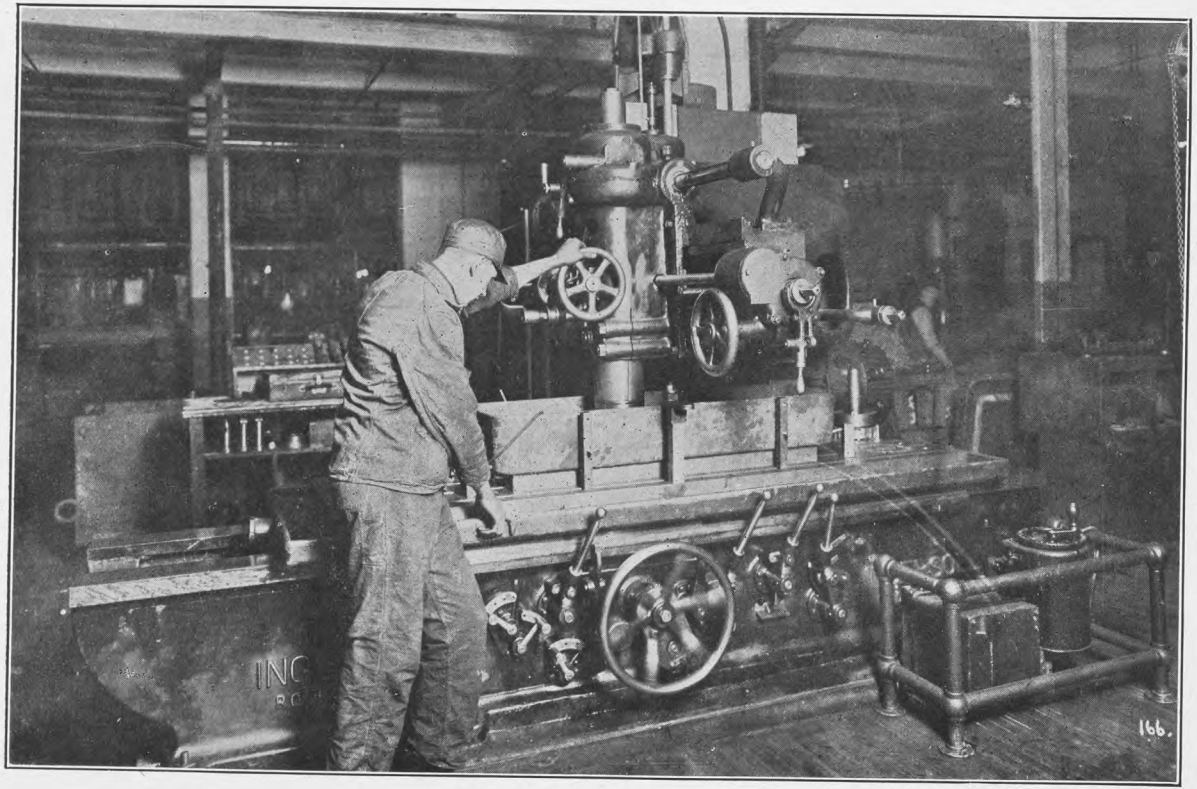

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PLATE X.—SURFACE GRINDER. GRINDING WHEEL HIDDEN FROM VIEW BY METAL GUARD.

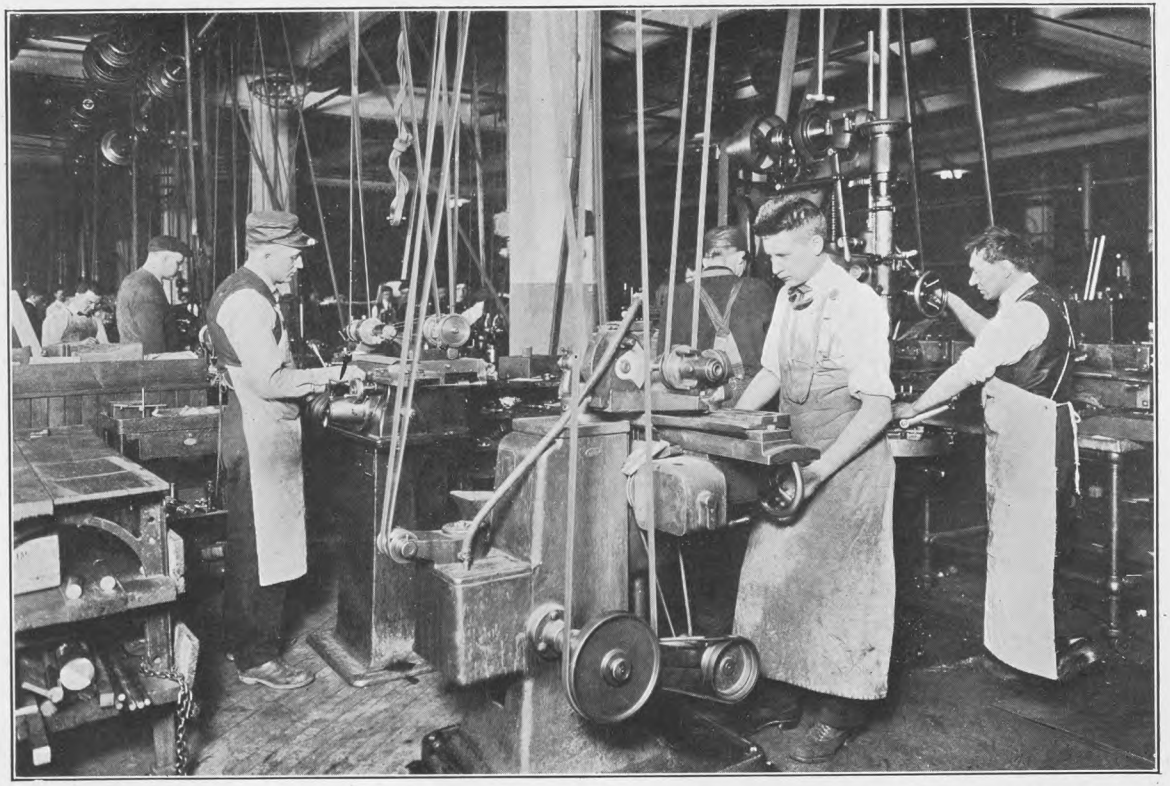

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PLATE XI.—EXTERNAL GRINDING.

Blue-print machine operator.[3]

Description of work.—The blue-print machine operator in one of the automobile factories studied ran the machine which made blue prints from the tracings sent in from the drafting room. He sat at a ledge or table attached to the machine and fed the blue-print paper from a roll in the box below onto a wide, moving, endless belt. As the blue-print paper moved along he placed the tracings on it. Paper and tracings moved under a convex plate of glass above which was a row of six arc lights. After printing the design, the machine carried the paper under a guard, to remove the tracings, through a stream of running water to develop it, and then over a rack containing a gas flame to dry. The machine was motor-driven, and the operator regulated its speed by shifting a foot lever. He had to know how to control the machine and the proper speed at which to run it.

Hazards or strains.—The glare of the arc lights involves some eye-strain, even when they are covered with a hood to reflect the light and to protect the operator's eyes.

Requirements.—An eighth-grade education is desirable. Any courses in drafting are valuable. Sixteen-year-old boys or girls may enter the occupation.

Learning period.—One week; three months to become proficient.

THE PATTERN SHOP.

WORK DONE.—Patterns to be used in making molds in the foundry and core boxes for making cores are made in the pattern shop. In the automobile-body factories, templates or exact patterns of every piece in the body, whether of wood or metal, are made from the sample body, which has been made up and approved previously.

MINORS EMPLOYED.—One minor was reported as a pattern maker; nine were pattern makers' apprentices.

Pattern maker's apprentice.[4]

Description of work.—An apprentice begins his training by doing odd jobs about the shop, sorting and storing patterns, and helping the other workers. As he becomes somewhat familiar with shop methods he is given small, simple patterns to make. As he works with the wood and the tools he becomes more skilled, so that he is able to do something a little more difficult. Later he is put to work on patterns that require the use of woodworking or metal-working machinery such as the band saw, the sander, the lathe, the grinder, etc.

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[3] For earnings, see Table 7, p. 16, where this occupation is classified under Machine operator—Other.
[4] For earnings, see Table 7, p. 16, where this occupation is classified under Apprentices.

Hazards or strains.—Machine-shop hazards.[5] Woodworking machinery used in making the woodern patterns is considered especially hazardous.

Requirements.—An eighth-grade education; in addition, some technical training is desired. Shop experience as a trucker or stock boy is valuable. The work is considered too hard for women.

Learning period.—An apprentice must serve four years to become a journeyman—a fact which indicates the skill demanded. Much skill and knowledge are needed to make the pattern so that it will come out of the mold easily (some have to be made in several pieces and put together with dowel pins) and allow for shrinkage of the metal as it cools and hardens.

THE FOUNDRY.

WORK DONE.—Castings for the heavier parts of machinery are made in the foundry. Sand used in making the molds is mixed, either by machine or by hand; molds are made, either at the bench (small molds), on the floor (large molds), or by machine; iron, melted in a cupola or other furnace, is poured into the molds. When cool the casting is taken from the mold and the loose sand knocked off.

FOUNDRY HAZARDS.—In factories in which there were foundries, employers usually considered the work there more hazardous than in any other department. Danger of burns from molten metal, of bruises, and of strain from heavy lifting, exposure to extremes of temperature and to blinding light from molten metal, and the smoke, gas, and dust of the workroom make the foundries unhealthful and often dangerous places in which to work. In the large foundries the overhead crane for carrying molten metal adds another element of danger. These dangers are guarded against in some factories by furnishing leggings, aprons, and gloves to the workers and by providing and operating adequate ventilating apparatus.

MINORS EMPLOYED.—Six boys in the establishments studied were working as molders, a few as apprentice molders and molding-machine operators; 1 was a pourer; 105 were working in the foundry, core room, or casting-cleaning department, as laborers, helpers, chippers, chill-pickers, rattling-room laborers, core cleaners, carriers or stackers, or wire boys, or at other occupations.[6]

Molder's apprentice and machine molder.[7]

Description of work.—The apprentice enters foundry work with the intention of learning the molder's trade. At the beginning he is practically no more than a helper, but, unlike an ordinary helper, he is given some of the simpler kinds of work the practice of which will help him in advancing to more important work. He learns the

[5] See p. 75 et seq.

[6] See pp. 70–72 for description of work in the core room and the casting-cleaning department. In the tabulation no distinction was made between the laborers in the foundry and in these two departments.

[7] For earnings, see Table 7, p. 16, where this occupation is classified under apprentices and molders.

method of moistening the sand and mixing it before it is made into molds, how to place the patterns in the flasks, how to ram the sand in the flasks, how to ventilate the mold, how to remove the pattern from the sand, how to set the cores, how to use the tools for repairing slightly broken molds, how to put on the parting or facing sand. These are all processes which require care and judgment obtainable only through experience in doing the work.

The work of one of the machine molders in a large foundry consisted of making molds for iron castings on the molding machine, which was operated by air pressure. A mold is a cavity (of the same form as the desired casting) made by packing sand around a pattern and then removing the pattern. The flask, or box-like frame which holds the mold, consists of two parts known as the "drag," or lower part, and the "cope," or upper part. Each is filled separately; the cope is then placed on top of the drag. To make the drag, the molder fastened the lower side of the pattern to the table of the molding machine and put a flask on the table around the pattern. He partly filled this flask with molding sand, put in wooden pegs called "soldiers" or gaggers" to hold the sand together, filled the flask full of sand, tapped it down, and smoothed it off. He then gently pushed a small wire down through the sand to make vent holes for the escape of the gas when the iron should be poured in, and placed on top a thin iron plate. There was another table on the machine above the mold, top side down, which, by turning a small lever, the operator lowered until it lay flat on the top of the flask. He turned another lever that caused both tables and the flask between them to jolt up and down, thus packing the sand tight in the flask. By turning a third lever the operator caused the machine to revolve the tables and flask so that the table to which the pattern had been fastened was on top. The turning of a fourth lever caused this table to vibrate slightly while the one now on the bottom was being slowly lowered; this made it possible to draw the pattern out of the mold without breaking the sand. The drag was then lifted by means of the iron plate on which it rested and placed on the floor. The molder wet the edges of the mold with a swab so that the sand would stick together and not crumble. Later he inspected the mold and repaired and smoothed any broken edges with a slicking tool. He also sifted a white parting powder onto the face of the mold so that the two halves would not stick together. Several drags were made at one time, then several copes to fit on top of them. The cope was made in exactly the same way as the drag except that in making the former a hole called the "sprue hole" was cut from the top of the sand down to the mold through which the molten iron might be poured. The complete operation of making drag and cope required about eight minutes.

Hazards or strains.—General foundry conditions and hazards.[8]

Requirements.—Most employers interviewed preferred molders who had had an eighth-grade education. Others said this was not absolutely necessary. School training in foundry work or experience in other foundries was considered desirable.

Because of the experience and physical strength required, only boys 18 years of age or older were employed as apprentices or as molders.

Learning period (molders).—From one to three years; from two to four years to become proficient. In some factories molders were required to serve an apprenticeship of four years.

Foundry laborer.[9]

Description of work.—The following description shows the work of a foundry laborer in one of the establishments visited. While the molders were making their molds he shoveled new molding sand from a bin onto his wheelbarrow and wheeled it to the molders who needed it. He also wheeled facing sand to the molders. While the iron was being poured he shoveled facing sand through a screen set up slantingly.

Hazards or strains.—General foundry hazards. The work may involve strain from heavy lifting.

Requirements.—No education is required, though some employers said they preferred workers with a common-school education. Experience is not required, but the work demands strength and endurance.

Learning period.—Less than three days; one day to a week to become proficient.

THE CORE ROOM.

WORK DONE.—In the core room cores are made to fit into the molds where holes or cavities in the castings are desired. Work here is on the whole lighter than in the foundry.

CORE-ROOM HAZARDS.—There is little accident hazard. The smoke and fumes from the core ovens are annoying and possibly harmful.

MINORS EMPLOYED.—Fifteen boys and sixteen girls were employed as core makers and 6 boys as core maker's apprentices. (See also page 68 under "Minors employed" for core-room laborers, helpers, etc.)

Core maker.[10]

Description of work.—The work done in one of the smaller foundries in making a core for the hub of an automobile-engine flywheel is illus-

[8] See p. 68.

[9] For earnings, see Table 7, p. 16, where this occupation is classified under Laborers and helpers—Foundry and core room.

[10] For earnings, see Table 7, p. 16, where this occupation is classified under Coremakers.

trative of the core maker's work. The worker first placed on a table in front of him a cylindrical iron core box (inside diameter about 8 inches and height about 6 inches) which was divided in halves and held together by thumb screws. In the bottom was a hole in which he inserted a seven-eighths inch pin long enough to reach the top of the box. He also inserted diagonally two one-half inch rods through holes in the sides of the box. In the completed core these rods make one large hole through the center and four smaller diagonal holes leading from the center to the outside which allow the molten iron to run through to the body of the flywheel. After the pins were in place the core maker filled the box with core sand, packed it down, and leveled it off with a heavy plate. Then he laid the plate on top, turned the box over, rapped it to loosen the core, took the box apart, and removed the pins, leaving the core on the plate. He then lifted plate and core to the rack on which it was to be baked in the core-baking ovens. After making about 15 cores he put kerosene on the pins and on the inside of the core box with a brush to prevent the sand from sticking to them.

Hazards or strains.—General core-room conditions and hazards.

Requirements.—Besides a good elementary education, the core maker should have a thorough knowledge of the method of handling core boxes and core sand. Experience as foundry or core-room laborer is of value.

Learning period.—In some factories it was reported that the work could be learned in a few weeks, but in others the employers said that two or three years' experience was needed to become proficient.

THE CASTING-CLEANING DEPARTMENT.

WORK DONE.—In the casting-cleaning department the castings from the foundry are cleaned and smoothed by sand blast, by grinding, and, if small in size, by rattling (or tumbling). Projections on the castings may be chipped off with a chisel.

CASTING-CLEANING DEPARTMENT HAZARDS.—The air is likely to be full of dust from the rattling process and from the sand blast.

MINORS EMPLOYED.—See page 68, under Foundry, minors employed.

Rattling-room laborer.[11]

Description of work.—It was the duty of one of the boys found working as a rattling-room laborer to pick up the castings after they had been taken from the rattlers, load them into a truck, and cart them to the bins at the other end of the room. As he unloaded, he sorted the different kinds and put them in their respective bins, throwing out the imperfect ones.

[11] For earnings, see Table 7, p. 16, where this occupation is classified under Laborers and helpers—Foundry and core room.

Hazards or strains.—Some physical strain is involved. The room is noisy and the air full of dust. Slight bruises and scratches may be incurred in handling the castings.

Requirements.—A common-school education is preferred but is not always required. The work demands considerable strength.

Learning period.—The work is very easy to learn.

THE FORGE SHOP.[12]

WORK DONE.—In this department, which is known in some factories as the blacksmith shop, parts requiring both lightness and great strength, such as cam shafts or crank shafts, are forged out from hot steel by the action of two-part dies in the steam hammer. The welding of pressed steel or other parts may be discussed here, though it is not always done in the forge shop.

FORGE-SHOP HAZARDS.—Burns from working with hot metal.

MINORS EMPLOYED.—Fourteen minors were working as heaters, four as welders, and a few as helpers and laborers. Work as hammerman, forge man, or blacksmith requires such strength and skill that minors can seldom qualify.

Heater.[13]

Description of work.—The heater observed in one forge shop picked up with long-handled tongs the pieces of iron which had to be heated before they were forged in the steam hammers, and placed them in the heating furnaces. He watched them to see that they reached the proper temperature for forging and replenished the supply as the hammermen's helpers took out the red-hot pieces. The furnaces were gas-heated ovens made of iron and lined with fire brick. The heater regulated the temperature by turning a valve in the pipe.

Hazards or strains.—Danger from the extreme heat of the workroom and risk of burns.

Requirements.—An elementary education is desirable but not always required. One employer said that any course dealing with the carbonization of metals would be valuable. The work is considered too hard for women.

Learning period.—One week or less; one week to one month to become proficient.

Blacksmith's helper.[14]

Description of work.—The work of the blacksmith's helper in one shop was to assist the blacksmith in whatever he might have to do. His usual duties were to keep clear the space around the forge,

[12] This department is not found in factories for which forgings are bought outside. In one factory studied, however, the principal product was drop-forged parts.

[13] For earnings, see Table 7, p. 16, where occupation is classified under Heaters.

[14] For earnings, see Table 7, p. 16, where occupation is classified under Apprentices.

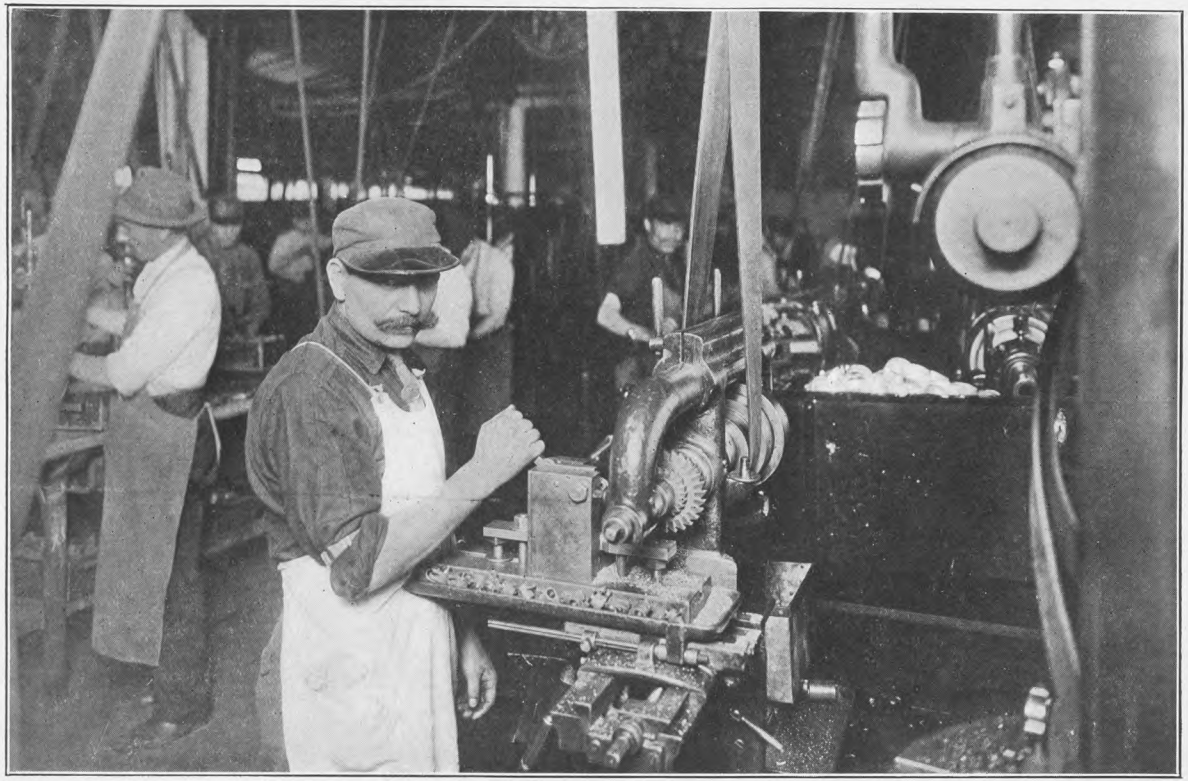

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PLATE XII.—MILLING MACHINE.

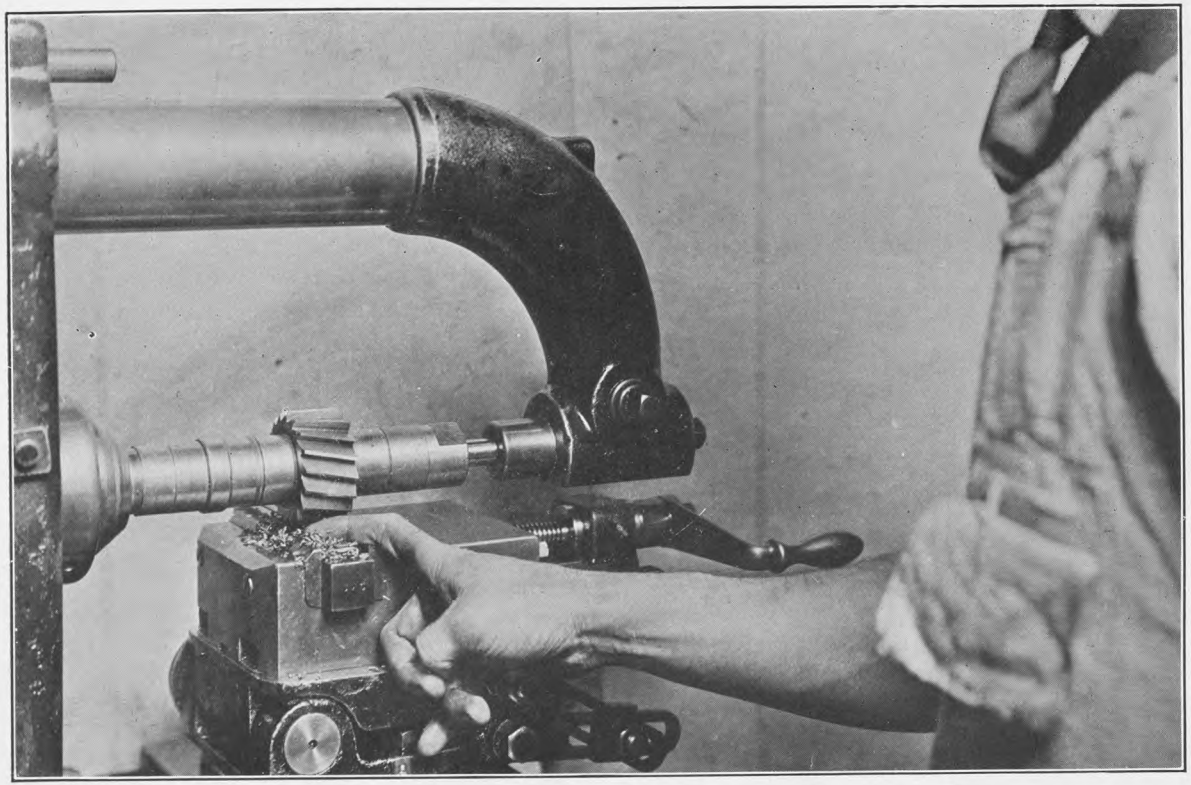

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PLATE XIII.—MACHINE SHOP. CUTTER ON MILLING MACHINE, ILLUSTRATING DANGER OF USING FINGER TO CLEAN OUT SHAVINGS.

keep the tools in place when they were not in use, hand the tools to the blacksmith when he asked for them, hold the end of the stock while the blacksmith was working on it, and act as hammerman to cut off stock or to form it while the blacksmith held the stock and the cut-off or forming tool. It was also his duty to keep coal on hand for the forge fire, and he might at times be given some of the simpler blacksmith work.

Hazards or strains.—The helper is in danger of being burned by flying sparks or by accidentally touching the hot iron and of being struck by particles of iron. In hot weather the temperature in the shop rises to a dangerous height. The work requires strength and endurance.

Requirements.—Eighth-grade graduates are preferred.

Learning period.—The work may be learned in one day and proficiency gained in a week or less.

Acetylene welder and electric-arc welder.[15]

Description of work.—The work of the acetylene welder may be illustrated by a description of the welding of the two halves of a pressed steel automobile rear axle housing. The worker placed them in a form and tightened it so that the corresponding edges of the two halves were held firmly together. This accomplished, he lighted his acetylene blow torch and adjusted it (by turning the screws which regulated the amounts of oxygen and of acetylene) until the flame became blue and produced heat sufficient for welding.[16] He then held the end of a piece of steel wire about a foot in length, made especially for welding of this kind, on the crack between the two halves of the axle housing, and directed the flame against the end of the wire and also against the parts to be welded. As the wire melted it ran into the crack; the metal edges of the parts also melted slightly and ran together. He continued this process until the whole seam on one side of the housing was welded, then revolved the form and welded the seam on the other side in the same manner.

The work of an electric-arc welder in the same plant is an illustration of another type of welding. When inspection showed imperfections in the acetylene-welded seams of the automobile rear-axle housings, they were sent to this worker for repair. He first placed the housing on a bench, the top of which was connected with one electrode. The other electrode was connected to a clamp which held the welding wire. He switched on the current, regulated the voltage by a rheostat,[17]

[15] For earnings, see Table 7, p. 16, where this occupation is classified under Blacksmiths, forge men, hammermen, and welders.

[16] Acetylene is a gas produced by the reaction between calcium carbide and water. This gas when mixed with air produces a very luminous flame, but when mixed with oxygen produces a heat intense enough to weld steel. The temperature of the flame may be varied by regulating the proportion of oxygen used.

[17] The rheostat is operated by turning a hand on a dial.

and holding the clamp by a handle rubbed the wire along the seam, lifting it up just enough to form an arc between it and the housing, thus melting the wire and the edges of the seam so that they ran together.

Hazards or strains.—The welder is liable to burns from flying particles of hot metal. The electric arc welder may also receive slight electric shocks. Dark goggles are usually worn to protect the eyes from the glare and flying sparks. The arc welder observed wore a metal helmet with a glass front, which afforded much better protection than goggles.

Requirements.—One of the three manufacturers who employed minors as welders preferred eighth-grade graduates and those who had had some technical training or experience as welders.

Learning period.—One or two months; from three to six months to become proficient.

THE HEAT-TREAT DEPARTMENT.

WORK DONE.—In the heat-treat department tools are tempered, forgings toughened by casehardening, dies hardened, sheet metal annealed ready for forming, and similar work done. The work of pickling sheet metal and forgings (that is, treating with acid baths in order to remove scale) is sometimes done in this department, sometimes organized separately. Other divisions of the work are made to suit convenience in different factories.

HEAT-TREAT DEPARTMENT HAZARDS.—The principal danger is from burns or from the acids used in pickling.

MINORS EMPLOYED.—Seven minors were working as heat treaters and seven as picklers.

Acetylene annealer. [18]

Description of work.—The work of the acetylene annealer observed in one factory was to anneal (or soften by heating) the metal around a 1-inch hole in a pressed-steel automobile rear axle housing cover, so that the operation of flaring this hole in the punch press would not crack the metal. The annealer set up a cover in a convenient position on his bench, adjusted the flame in the acetylene blow torch (see p. 73) and directed this flame against the metal around the hole until it was cherry red to a distance of about 1 inch around the hole. He then put this cover aside to cool slowly in the air while he repeated the operation on another.

Hazards or strains.—Goggles are worn to protect the worker's eyes from the glare of the torch as he sits at his bench. There is some danger from burns.

[18] For earnings, see Table 7, page 16, where occupation is classified under Heat treat.

Requirements.—Eighth-grade education preferred. The work is too heavy for women or for boys under 18.

Learning period.—A week or less; one month to become proficient.

Casehardener's helper.[19]

Description of work.—In one factory the casehardener's helper assisted the casehardener in any way possible, as by handing him tools, cleaning the shop, and casehardening small parts, such as cams. In doing the latter work he picked up the cam with tongs, placed it in a small gas furnace, and left it there until it reached a cherry-red color. He then took it out with the tongs and rubbed it in powdered potassium cyanide until it was covered (this powder melts and forms a thin film over the cam). After this he quenched the cam in water and allowed it to remain there until perfectly cold.

Hazards or strains.—The helper whose work is described wore goggles to protect his eyes from the glare of the fire and the hot metal. In quenching the red-hot cam he must stand far enough away to avoid getting spattered with hot water.

Requirements.—Eighth-grade graduates are preferred. In one factory tool hardening was considered so skilled a job that minors were seldom able to qualify for it, but in the others visited hardening did not require much skill.

Learning period.—One week; six months to become proficient.

THE MACHINE SHOP.

WORK DONE.—Parts from the foundry and forge shop are sent to the machine shop to be machined to exact size and finished.

MACHINE-SHOP HAZARDS.—Danger from belts, shafts, and gears, and from the moving parts of each machine makes this department one of the most dangerous in the factory. Hazards vary with the different types of machines. A large proportion of machine accidents occur on drill presses. Punch presses were named as the most dangerous machines because of the large number of dismemberments for which they were responsible. The guards provided almost invariably reduce output; consequently, the operator, working on piece rate, is tempted not to use them. In one factory the manager, believing that young workers had not the ability to concentrate attention on their work the whole day through and were therefore more liable to accident as punch-press operators than adults, took all workers under 21 from the presses. Accidents to punch-press operators fell as a result from an average of two in one month to two in the eight months in which the new policy had been in effect. The use of motor-driven instead of belt-driven machinery; efficient

[19] For earnings, see Table 7, p. 16, where this occupation is classified under Laborers and helpers—Others.

guards on all machines, shafts, gears, and belts; and proper clothing regulations have proved effective in reducing the hazards.

MINORS EMPLOYED.—In all, 619 minors, or about one-fifth of the total number, were employed as machine operators. As is shown by Table 29, 123 of them were working as drill-press operators, 99 as grinders, 98 as lathe operators, 89 as milling-machine operators, and 210 as operators on other kinds of machines. Two girls and 62 boys were classified as machinists other than repair men; of these, 38 were testers, 14 adjusters, and 12 machine setters or other machinists.

TABLE 29.—*Kind of machine operated, by sex; minors in metal-manufacturing industries.*

Kind of machine operated.	Minors in metal-manufacturing industries.			Kind of machine operated.	Minors in metal-manufacturing industries.		
	Total.	Boys.	Girls.		Total.	Boys.	Girls.
Total	2,840	2,536	304	Machine operators—Contd.			
Machine operators	619	542	77	Boring	11	11	.....
Drills	123	115	8	Broach	6	6	.....
Speed	4	4	.....	Planers	3	3	.....
Other [1]	119	111	8	Presses	22	19	3
Grinders	99	98	1	Punch-press	18	15	3
External	21	21	.....	Stamp-press	3	3	.....
Internal	8	8	.....	Other [1]	1	1	.....
Surface	2	2	.....	Saws	13	13	.....
Hand	1	1	.....	Screw	29	29	.....
Tool	27	26	1	Hand screw	9	9	.....
Other [1]	40	40	.....	Automatic screw	5	5	.....
Milling	89	81	8	Other [1]	15	15	.....
Hand	3	3	.....	Sewing	26	.....	26
Gear	15	13	2	Gear shaper	1	1	.....
Other [1]	71	65	6	Other shapers	4	4	.....
Lathes	98	94	4	Shears	5	5	.....
Turret	20	19	1	Tapping	8	6	2
Low swing	2	2	.....	Thread	26	11	15
Other [1]	76	73	3	Other machine operators	56	46	10
				Not machine operators	2,221	1,994	227

[1] Includes not specified.

REQUIREMENTS.—Employers as a rule preferred operators who had had at least a sixth or seventh grade education and several preferred eighth-grade graduates. Most of them considered any technical training in machine-shop work valuable. Many machine operators need sufficient knowledge of drafting to read simple blue prints.

Drill-press operator.[20]

Description of work.—The work of a drill-press operator in one of the machine shops visited was to drill five holes in a casting, using a four-spindle, high-speed drill press. He put the casting in a jig made for this particular piece of work and clamped the cover of the jig firmly over it. (A jig is a device for holding work while drilling; bushings in the jig indicate the size and location of the holes to be

[20] For earnings, see Table 7, p. 16, where this occupation is classified under Machine operators—Drills.

drilled.) Then he lifted the jig and casting to the drill-press table. The drill press was equipped with four spindles (devices to hold the drilling tool), three holding drills of different sizes, and one holding a reamer (a tool used to enlarge a hole). The operator pulled down on a hand lever which brought the drill down through the hole in the jig where it bore on the casting until the hole was drilled. He drilled another hole with the same drill, then two holes with the drill next larger in size which was on the second spindle, then a large hole with the drill on the third spindle. Through the last hole he ran the reaming tool which was on the fourth spindle. The whole operation took about four minutes.

Hazards or strains.—Even with the machine well guarded, there is some danger from breaking drills and from contact with the moving drill. The operator stands at his work and must watch it very closely.

Requirements.—The operator should be able to read simple blue prints. Very little skill is required, since the holes in the jig indicate the position and size of the holes to be drilled. In two factories girls were working as drill-press operators.

Learning period.—As a rule operation of the machine can be learned in a few weeks at most and proficiency attained in a few months.

Surface-grinder operator.[21]

Description of work.—Surface grinding is the term applied to grinding smooth a flat surface. The work of one of the surface-grinder operators in an automobile factory was to grind down the top surface of a die shoe until the tool marks of the shaper used to finish it were ground off and the surface left perfectly smooth. The operator placed the die shoe in position on the horizontal table of the grinder, where it was held in place by magnetic attraction, adjusted the grinding wheel to the correct position by turning the handwheel, threw the long hand lever that shifted the countershaft clutch, shifted the clutch on the machine, and when he was sure that everything was in position shifted the small hand lever that threw in the automatic feed. The grinding wheel, driven by a vertical spindle, was of emery and measured 14 inches in outside diameter and 12 inches in inside diameter. The table of the machine was automatically fed up as it moved back and forth, the amount of the feed being adjusted by the operator in accordance with instructions from the foreman.

Hazards or strains.—The machine was well guarded, so that the hazard was slight, although there was some danger from the breaking of the wheel and from flying particles. Since this was dry grinding there was some dust in spite of the suction pipe attached.

Requirements.—See machine-shop requirements. Truckers and rough grinders are frequently promoted to this position.

[21] For earnings, see Table 7, p. 16, where this occupation is classified under Machine operators—Grinders.

Learning period.—Two to six weeks; six weeks to six months to become proficient.

External grinder.[22]

Description of work.—This type of grinding is illustrated by the work of a boy who was grinding piston rings on an external-grinding machine to correct outside diameter. To prepare the rings for the machine he slipped them on a rod about an inch in diameter which was threaded on one end and on the other fitted with a flange or base somewhat smaller in diameter than the piston rings were to be when finished. He separated each five rings by a plate of the same diameter as the base of the rod and put such a plate at the end when the rod was filled. Before screwing on the bolt which held all the rings in place on the rod he put the whole in a casing, made with its two halves hinged together, and tightened the bolts of the casing to bring all the rings to a uniform position concentric with the rod. By tightening securely the nut on the end of the rod the rings were held in position and the casing could be taken off. The operator then placed the rod with the rings on it in position between the centers of the grinding machine, tightened it, and pushed the lever to start the machine, which revolved the work and moved it automatically back and forth against the revolving emery wheel. The wheel also moved automatically toward the work. The operator had to measure with calipers occasionally to determine whether the rings were ground to correct size. While the machine was grinding, the operator set up new work.

Hazards or strains.—On this machine cutting fluid was used, so that there was no dust from the work. The gears, emery wheel, and other moving parts were well guarded. Minor bruises and scratches might be received while setting up the work and putting it in the machine. The grinder stood all day, lifted the work to the machine, and had to read the measurements carefully.

Requirements.—Operators should have at least a common-school education and be able to read simple blue prints and to use the micrometer calipers. Boys at least 18 years of age were preferred for the work.

Learning period.—One to six weeks in most of the factories visited, but one employer said that it might take an operator three years to become proficient.

Internal grinder.[22]

Description of work.—Internal grinding may be illustrated by the work of a boy who was grinding the inside of a cylinder. He bolted a fixture plate to the flange of the cylinder, hooked cylinder and

[22] For earnings, see Table 7, p. 16, where this occupation is classified under Machine operators—Grinders.

plate to an air hoist, and raised them by means of this hoist to a fixture on the machine. To this fixture he bolted the plate already fastened to the flange of the cylinder. He started the machine by shifting a long lever which reached to the shaft near the ceiling; then shifting another lever on the machine he started the automatic feed, which caused that part of the machine to which the cylinder was attached to slide back and forth. As the cylinder moved, its inside surface came in contact with a high-speed grinding wheel mounted on an eccentric spindle which moved the wheel slowly around the inside of the cylinder. At each revolution of this spindle the operator gave the small wheel which controlled it a quarter turn, causing it to describe a larger circle and so grind a little deeper into the cylinder. He measured the inside diameter of the cylinder occasionally with calipers through a hole in the sheet-iron guard, and stopped the machine when the size was correct. The whole operation took about 15 minutes.

Hazards or strains.—Some of the iron and emery dust got into the eyes and nose of the operator, in spite of the suction hose attached to the cylinder to carry it away. He was in some danger of being hit by the revolving spindle while taking measurements, or by the fast-moving belt which drives the emery wheel if this belt should break. The worker stood all day and had to watch the work closely and read measurements accurately.

Requirements and learning period.—Same as for external grinders.

Reamer-grinder operator.[24]

Description of work.—Tool grinding may be illustrated by a description of the work of sharpening plain fluted reamers (tools used on the drill press) in one of the large automobile factories visited. The grinder used was a small emery wheel about 6 inches in diameter and five-eighths of an inch thick, running at high speed. The operator put the reamer between the centers on the machine which were made to hold it; pushed the lever controlling the cross feed, which moved the tool up to the grinding wheel; and pushed the lever controlling the lengthwise feed, which moved the tool across the grinding wheel to take the cut. Since the reamer was fluted, the edge of each fluting had to be ground to the same angle. After grinding the first edge, the operator read the dial on the cross feed which indicated just how far the reamer had been moved toward the grinding tool. Then he revolved the reamer in its rest until the edge of another fluting was in position and pushed the lever on the cross feed till the dial read the same as for the first operation. This was repeated till all the edges were ground.

[24] For earnings, see Table 7, p. 16, where this occupation is classified under Machine operators—Grinders.

Hazards or strain.—The machine was guarded in such a way as to protect the operator from flying pieces in case the wheel should break. Since no fluid was used in grinding there was some dust.

Requirements.—Common-school education preferred. Courses in tool making and experience in other kinds of grinding are valuable.

Learning period.—Somewhat longer than for the types of grinding discussed previously.

Milling-machine operator.[25]

Description of work.—This process may be illustrated by the work done in operating a hand milling machine to mill the two sides of a block or pin used as an automobile-brake cable end. As the block came to the operator it was cylindrical; the machine sliced off enough metal to make two parallel plane surfaces. A clamping fixture holding four of these blocks at once was fastened to the table of the machine. The two milling cutters on the arbor of the machine were spaced just far enough apart to cut the two sides of the block at the same time. The operator put four blocks in the jaws of the clamping fixture, fastened them securely by tightening the jaws with a hand lever, and fed the table of the machine up to the cutter by turning a hand crank. After the cuts were completed on all four blocks, he moved the table back by reversing the hand crank and took the blocks from the clamping fixture. The complete operation required about one minute.

Hazards or strains.—General machine-shop hazards. Cutting compound is fed automatically on the tool while cutting.

Requirements.—General machine-shop requirements. Minors under 17 were not employed.

Learning period.—About two weeks in most factories. In one factory three years were required to become proficient, but in most of them proficiency could be gained in less than one year.

Screw-machine operator.[26]

Description of work.—The work of a hand turret-screw machine operator in one of the machine shops visited was to cut off pieces 6 inches in length from a long bar of round cold-rolled steel stock, after drilling a hole in one end, chamfering the edge of this hole, and chamfering the outside edge of the other end of the piece. By pulling forward a lever the operator drew the bar of stock through the lathe center up against a stop in the turret head. The turret head, which was placed on the bed of the lathe opposite the lathe center, had six sides, of which five, holding respectively a stop, a center drill, a drill, an inside chamfering tool, and another stop, were used in this operation. As the operator moved this turret back by

[25] For earnings, see Table 7, p. 16, where this occupation is classified under Machine operators—Milling.
[26] For earnings, see Table 7, p. 16, where this occupation is classified under Machine operators—Screw.

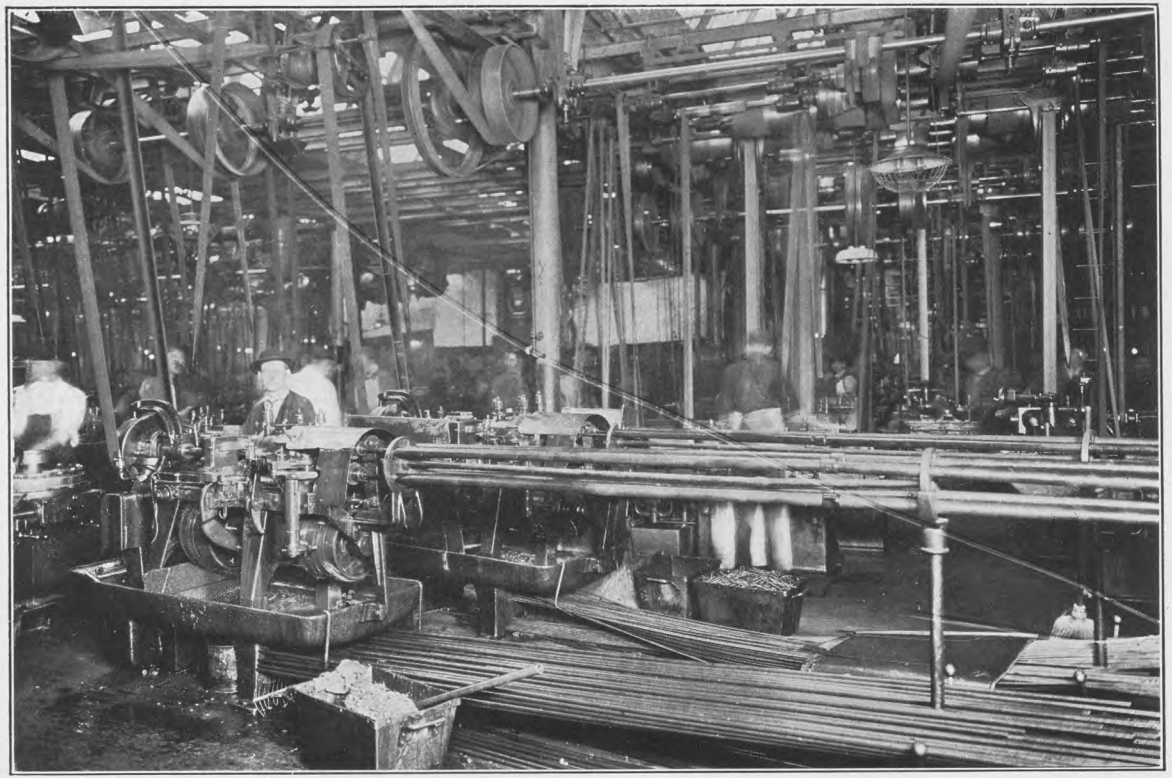

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PLATE XIV.—MACHINE SHOP. AUTOMATIC SCREW MACHINE.

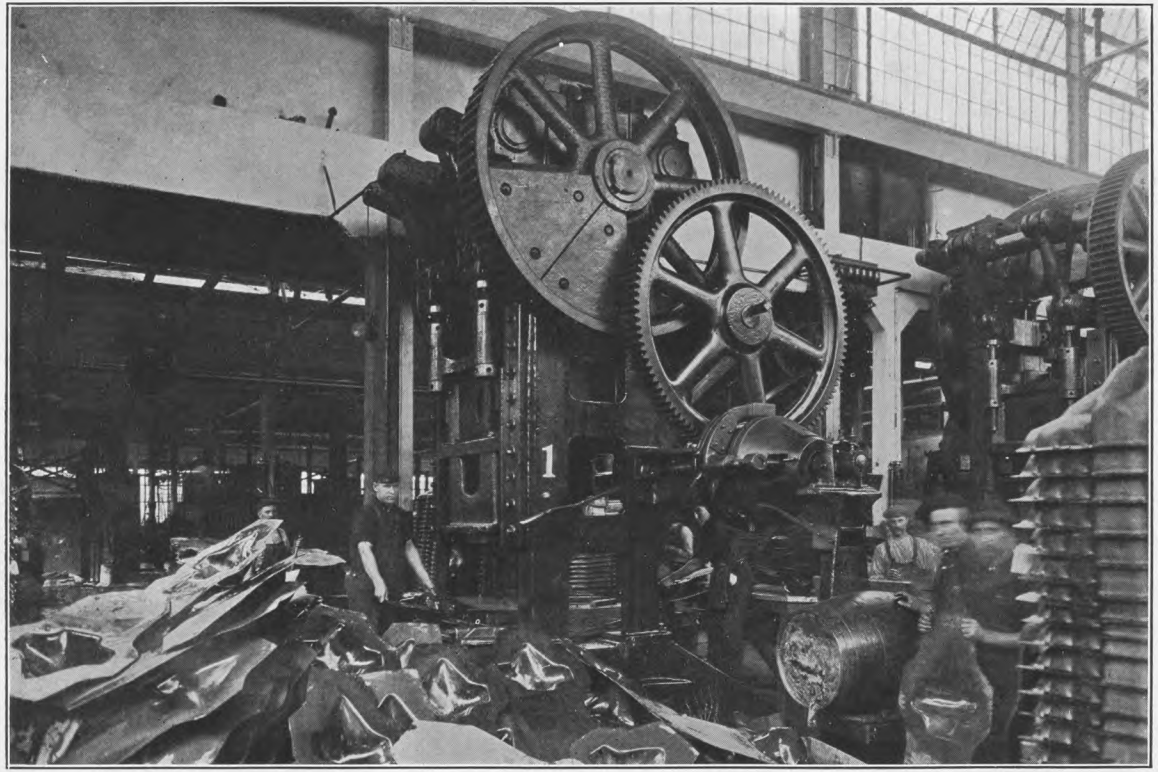

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PLATE XV.—PUNCH-PRESS DEPARTMENT, HEAVY. PUNCHING OUT REAR-AXLE HOUSINGS.

hand lever it automatically rotated through 60°, bringing the center drill in line with the center of the bar. Then, as he pulled the hand lever forward, the tool in the turret head drilled the center in the revolving bar. In the same way he drilled the hole and chamfered its inside edge. With the hand lever he then moved the work up to the stop (the fifth tool in the turret head) which indicated the correct location for the use of the outside chamfer and cut-off tools held in the tool posts of the cross feed, one on one side of the work and one on the other. He operated first the chamfering tool, by hand lever, across the machine in one direction, and then the cut-off tool by pulling the same lever back again. The whole operation required about four minutes. It is similar to other kinds of work on a turret lathe.

Automatic screw machines perform automatically all the operations described above. The operator may tend four or more such machines, oiling them, regulating the flow of the cutting compound, taking away shavings if they are clogging the machine, replacing dull tools with sharp ones, and putting in new stock.

Hazards or strains.—Scratches and cuts to hands and fingers from contact with the moving parts of the machine, and injury to the eyes from flying particles. Gears and motor on the machine observed were guarded. Strain is involved in the close watching of the work and in the speed of production.

Requirements.—Besides knowing how to control the machine, the operator should be able to read simple blue prints. (See also general machine-shop requirements.)

Learning period.—Generally a few weeks.

Boring-machine operator.[27]

Description of work.—Operation of the boring machine may be illustrated by the work of a boy who was boring out the hub of a flywheel casting on a vertical boring machine with automatic feed down and from right to left. He fastened a hook into the flywheel, lifted it by means of chain hoists, and rolled it to the table of the boring machine along the track which supported the hoist. He unfastened the hook, moved the wheel into place on the table, and fastened it there securely by turning a crank in the universal chuck (or clamp), which was located on the table in such a position that the center line of the hub was exactly in line with the center of the boring tool bar. He then started the machine by shifting the clutch on the overhead countershaft by means of a long lever. He loosened the turret head on the machine, which contained three tools, by moving a hand lever and swung it around until the first boring tool

[27] For earnings, see Table 7, p. 16, where this occupation is classified under Machine operators—Other.

came automatically in line with the center of the hub. He then clamped the turret head firmly by hand lever, so that there would be no danger of its turning loose, and pushed a small gear into mesh by hand, which caused the machine to feed the boring tool automatically through the hub. This cutting operation finished, the operator raised the turret by a hand crank and revolved the head to position so that the next boring bar was in line with the center of the hub. Again he threw in the small gear by hand and this second boring tool was fed through the hub automatically. Then, having raised the turret head and swung it until the reamer was in place, he fed the reamer through the bored hole by using a hand crank, oiling the reamer to obtain a smooth cut. After this he released the jaws of the universal chuck, raised the flywheel from the table by the chain hoist, and conveyed it to a pile of finished work. The time of operation was about eight minutes.

Hazards or strains.—General machine-shop hazards.

Requirements.—The operator should be able to read simple blue prints. (See also general machine-shop requirements.)

Learning period.—Length of time to become proficient varies from a month to three years, depending upon the nature of the work.

Punch-press operator.[28]

Description of work.—The work observed was that of forming on a heavy punch press the flange of a 12-inch disk. Two operators worked at this machine, one to insert the disk and to trip (or start) the machine, the other to take the disk out of the machine after it had been formed. The first operator put the disk on the lower part of the die between four pins which held it in correct position, and then pressed down on the foot pedal. This caused the upper part of the die to come down onto the lower part and in so doing to press the disk down over it, thus forming a flange. After the flange was formed the upper half of the die moved up to its original position and the machine stopped. The second operator then took the work from the die; sometimes it slipped off easily and sometimes it stuck so that he had to use a small hook to loosen it.

Hazards or strains.—It was impossible for the machine observed to operate unless the foot lever was first pressed, but the danger was that the work might become so monotonous that the operator would thoughtlessly press his foot on the pedal at the wrong time and cause an accident. (See general machine-shop hazards.)

Requirements.—General machine-shop requirements.

Learning period.—The experience stated by employers as necessary to become proficient as a punch-press operator varied from a week in one factory to a year in another.

[28] For earnings, see Table 7, page 16, where this occupation is classified under Machine operator—Press.

Tapping and threading-machine operators.[29]

Description of work.—The work of a tapping-machine operator in one of the automobile factories visited was to tap out (or cut) one-half inch screw threads in specially shaped nuts. The tapping tools were held in chucks (or clamps) and projected upward, while the nuts were held in place by small spring clamping devices fastened to spindles that projected downward in line with the tapping tools. The machine had five spindles so that five nuts might be tapped at one time. The operator slipped the five nuts into the clamping devices, fastened them in place on the spindles, and pushed down on a hand lever that pressed down the spindles and revolved them so as to make the tapping tools cut the threads in the nuts. The amount of travel of the spindles was regulated by a stop on the machine; when this was reached the operator pulled up on the hand lever causing the spindles to reverse their rotation and screw the nuts off the tap. A cutting compound was automatically fed into the work by a small circulating pump.

The hand threading-machine operator observed was cutting screw threads for about two inches on the end of a valve stem. He placed the valve stem between the jaws of the clamp in the machine and tightened the clamp by turning a hand wheel, then threw a small lever on the die which drew its cutting tools close enough together to make threads on the valve stem. (The size was regulated by a stop on the machine already set.) Then he pushed the valve stem into the revolving die until the die cut a few threads, after which it automatically drew in the stem. After about 2 inches had been threaded the operator spread the cutting tools of the die by reversing the lever, opened the clamp of the machine, and removed the valve stem. Oil was automatically fed onto the die and the valve stem. The whole operation required about one minute.

Hazards or strains.—This is one of the simpler and less hazardous machine operations.

Requirements.—General machine-shop requirements.

Learning period.—One day to two weeks; as a general rule, one to six weeks to gain proficiency

Die setter.[30]

Description of work.—When a piece of sheet metal is to be punched or formed, or both, a die is made in such a way that when its two halves are pressed together the piece will be pressed or punched into the desired form. It is the die setter's work to put the die in the punch press and so to adjust it that the work will be turned out

[29] For earnings, see Table 7, page 16, where these occupations are classified as follows: Tapping, under machine operator—Other, and Threading under Machine operator—Thread.

[30] For earnings, see Table 7, page 16, where this occupation is classified under Machinists—Setters.

accurately. Whenever a machine turns out imperfect work the die setter examines the die and repairs it if possible. If it is broken so that it can not be repaired in his department, it is sent to the die-repair department of the tool room.

Hazards or strains.—The operator is liable to accident while repairing or setting the dies in the machines. (See general machine-shop hazards.)

Requirements.—Die setters should be good mechanics and be able to read common shop blue prints. Experience as machine operators is necessary. (See also machine-shop requirements.) This is one of the more skilled of the jobs in the machine shop.

Learning period.—A machine operator needs three months or more to become proficient as a die setter.

Set-up man for screw machine.[31]

Description of work.—The screw machine set-up man in one of the factories visited was required to keep in adjustment one automatic and five hand screw machines, of the turret screw-machine type. The turret heads are hexagon shaped with six tool sockets, one on each face of the turret. The tools used, including center drills, drills, threading dies and taps, reamers, chamfering tools and stops, varied according to the nature of the work to be done. The work of the set-up man was to place in the machine the long rod of bar stock from which the screws were made so that its center would line up exactly with the tool sockets in the turret, to line up the tools and stops in the turret, so that the pieces would be cut to correct length, and to adjust the travel of the turret so that each tool would do exactly the work required of it.

Hazards or strains.—The worker's hands and fingers may be pinched, cut, or scratched while setting up machines and trying them out. This also is one of the more skilled jobs.

Requirements.—Experience in machine operation, accuracy, and responsibility, and an understanding of blue prints of small parts.

Learning period.—Three years.

Set-up man and foreman.[32]

Description of work.—It was the duty of a set-up man and foreman in one shop visited to set up all the machines in his department and to oversee all work done, occasionally checking the finished work of each operator to see that it was being done accurately. The following were the machines under his supervision: Four milling machines, one cam miller, three lathes, two drill presses, one piston-ring slotting machine. He used calipers, micrometers, scales, combination sets

[31] For earnings, see Table 7, p. 16, where this occupation is classified under Machinists—Setters.

[32] For earnings, see Table 7, p. 16, where these occupations are classified as follows: Set-up man under Machinists—Setters; foreman under foreman and superintendents.

(composed of center head and level), wrenches, screw drivers, and other tools.

Hazards or strains.—General machine-shop hazards.

Requirements.—As set-up man, the worker must understand thoroughly the operation of all the machines under his supervision, and, as foreman, he must be able to supervise others, check up work readily, and teach new workers. This is one of the skilled jobs of the shop, to which few workers under 21 had advanced.

Learning period.—Three years.

Machine-shop trucker.[33]

Description of work.—The trucker in one shop visited was using a two-wheeled two-handled hand truck to move cylinders from one machine to another for the different operations. He had to keep 16 machines supplied with cylinders.

Hazards or strains.—Physical strain from lifting cylinders weighing between 50 and 75 pounds from the pile to the floor and carrying them from one pile to another, and also from lifting the handles of the truck when it was loaded with two cylinders. Some danger of jamming and pinching fingers and hands between heavy cylinders.

Requirements.—Little education or training was necessary. The worker must learn the location of the machines he is to supply and the sequences of the operations performed.

Learning period.—About an hour; proficiency gained generally in a week.

THE TOOL ROOM.

WORK DONE.—Tools, jigs, dies, and fixtures for the machines are made in the tool room. Though more varied and highly skilled, the work does not differ greatly from that of the machine shop.

MINORS EMPLOYED.—Fifteen boys were working as toolmakers and 14 as apprentice toolmakers. Some of the boys classified as repairmen[34] were working in this department as "tool-trouble" men and die repairers, and at other types of repair work.

Bench work, die-repair man.[35]

Description of work.—In one of the pressed-steel factories visited dies which had been broken in the machine shop in such a way that they could not be repaired there were sent to a die-repair man. With each die were instructions for repairing it and sometimes a blue print of it. To put these dies in perfect condition necessitated all-round machine work as well as fitting and assembling on the bench.

Hazards or strains.—General machine-shop hazards.

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[33] For earnings, see Table 7, p. 16, where this occupation is classified under Laborers and helpers—Truckers.

[34] See Table 7, under Machinists, for numbers employed.

[35] For earnings, see Table 7, p. 16, where this occupation is classified under Machinists—Repair.

Requirements.—A common-school education with preferably a high-school or trade-school course, ability to read comparatively difficult shop blue prints, and experience in operating all the common machine-shop machines.

Learning period.—Two to four years.

THE SHEET-METAL DEPARTMENT.

WORK DONE.—In automobile-body factories the sheet-metal department, where metal parts are cut and formed to fit over the wooden body, is an important one. In other factories also, which use sheet metal in manufacturing, the metal parts must be cut, formed, and punched.

SHEET METAL DEPARTMENT HAZARDS.—The machines used are dangerous, particularly the small punch presses.

MINORS EMPLOYED.—Twenty-three boys were employed as sheet-metal workers and a few as hammerman's helpers, rotary-sheer operators, punch-press operators, or laborers and helpers. (For discussion of punch-press operators, see page 82.)

Sheet-metal marker.[36]

Description of work.—The sheet-metal marker in an automobile-body factory marked out on sheet iron the shapes used in making up the metal parts of the automobile bodies. He laid the sheet iron on a table made especially for this work, placed a template or pattern on top of the sheet iron, and marked all around it with a steel marker, thus transferring the outline of the template to the sheet iron. He had a number of differently shaped templates and tried to fit them on the metal in such a way as to waste as little of it as possible.

Hazards or strains.—Little hazard in this occupation.

Requirements.—Little skill necessary.

Learning period.—Proficiency can be acquired in about one day.

Rotary-shear operator.[37]

Description of work.—The work of the rotary-shear operator in the same factory was to guide a sheet of metal through the rotary shears so that a piece would be cut out according to the design marked on the metal by the marker. The rotary-shear machine has two revolving disks about 3 inches in diameter, made of very hard tool steel. They are sharpened on the edges and adjusted to cut like a pair of shears. A table is provided, the top of which is in line with the point where the edges of the two wheels meet. The operator placed on this table the sheet to be cut and guided it

[36] For earnings, see Table 7, p. 16, where this occupation is classified under Sheet-metal workers.

[37] For earnings, see Table 7, p. 16, where this occupation is classified under Machine operators—Other.

through the shears so that the disks would cut along the line drawn on the sheet.

Hazards or strains.—The operator wore gloves to protect his hands in handling the sheet metal. He had to watch the work closely to guide it between the shears exactly on the marked line.

Requirements.—Eighth-grade graduates were preferred. Boys under 18 were not employed. Experience as a helper was required.

Learning period.—About a year is necessary to become proficient.

Hammerman's helper.[38]

Description of work.—In forming the cowl, the rear end, and some other parts of the automobile body, the sheet iron can not merely be bent to shape but must be formed; that is, parts of it must be stretched to give the correct shape; this must be done very smoothly so that there will be no wrinkles or seams. The work is done in the power bumping hammer. Two helpers stand one on each side of the hammerman and hold up the sheet iron so that he may devote his attention to guiding it under the hammers.

Hazards or strains.—Physical strain of holding up the heavy metal. The workers wear gloves while handling the sheet iron. Noise from the bumping hammers is loud and incessant.

Requirements.—The work, while not skilled, requires such strength that boys under 18 and women are not employed.

Learning period.—A few minutes; proficiency gained in a week.

Sheet-metal flanger.[39]

Description of work.—The work of one of the sheet-metal flangers in an automobile-body factory was to turn down an edge or flange three-fourths of an inch wide on a piece of No. 24-gauge sheet iron to be used for the automobile rear-wheel housing. The flanger laid the panel of sheet metal to be flanged upon a thick cast-iron form, the top and edges of which conformed to the shape of the finished work. Stops were provided that allowed the edge of the sheet-metal panel to extend the necessary distance beyond the form. To hold the panel firmly in place the flanger brought down on top of it another form made in the same shape, hinged to the first, and clamped them together. He then hammered down the edge with a wooden hammer until it was smooth.

Hazards or strains.—The worker observed wore gloves to protect his hands from cuts and stratches.

Requirements.—Eighth-grade graduates were preferred. Boys under 17 were not employed.

Learning period.—Two days; a week to become proficient.

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[38] For earnings, see Table 7, p. 16, where this occupation is classified under Laborers and helpers—Other.

[39] For earnings, see Table 7, p. 16, where this occupation is classified under Sheet-metal workers.

Door paneler.[40]

Description of work.—A door paneler in an automobile-body factory visited was attaching hinges to the frame of an automobile door and putting the sheet-iron covering over the outside of the door. He placed the wooden doorframe (already fitted with the latch) on a form which rested on a bench and was just large enough to accommodate it. Then he pulled down a lever which lowered upon the doorframe a clamping device with four stops to hold the frame firmly in place in the form and put the two hinges in slots provided for them, so as to make their flanges flush with the frame. He next drilled the bolt holes with an air drill. He started the drill by turning a lever which let in compressed air and pressed its point on the spot where the hole was to be drilled. Next he put in the eight stove bolts, four for each hinge. On each bolt he put one plain washer against the wooden frame, one lock washer and a nut, then screwed in the bolt and tightened it with a spiral screw driver. After putting the hinges on the frame, he released the clamp that held it and took it out of the form. Then he placed on the form a panel of sheet iron already shaped to fit the frame, laid the frame on it, and by means of the clamping device before used pressed the frame down into the panel. With small nails he then nailed the flange of the panel to the edge of the doorframe, holes being provided in the flange for this purpose. The operation required about five minutes.

Hazards or strains.—Possibility of minor bruises and cuts. Physical strain from standing all day; nervous strain of rapid production.

Requirements.—Eighth-grade graduates are preferred. Boys under 18 are not employed.

Learning period.—Six weeks; two months to become proficient.

Body finisher.

Description of work.—The work of a metal-body finisher in one of the establishments visited was to smooth the metal part of the automobile body so that no rough places or bumps would show after it was painted. The body came to this department with all hollows and dents that could not be straightened out filled with Babbitt metal. The finisher went over the whole surface smoothing it down with files of different grades, some coarse and some fine. If considerable filing had to be done he used first a coarse, fast-cutting file until the projection was nearly removed, then a finer file for finishing. In filing a surface of such breadth that the ordinary file handle would interfere with the strokes of the file, he used a special handle called a "surface file holder."

Hazards or strains.—Little hazard involved.

[40] For earnings, see Table 7, p. 16, where this occupation is classified under Sheet-metal workers.

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PLATE XVI.—LIGHT PUNCH PRESS.

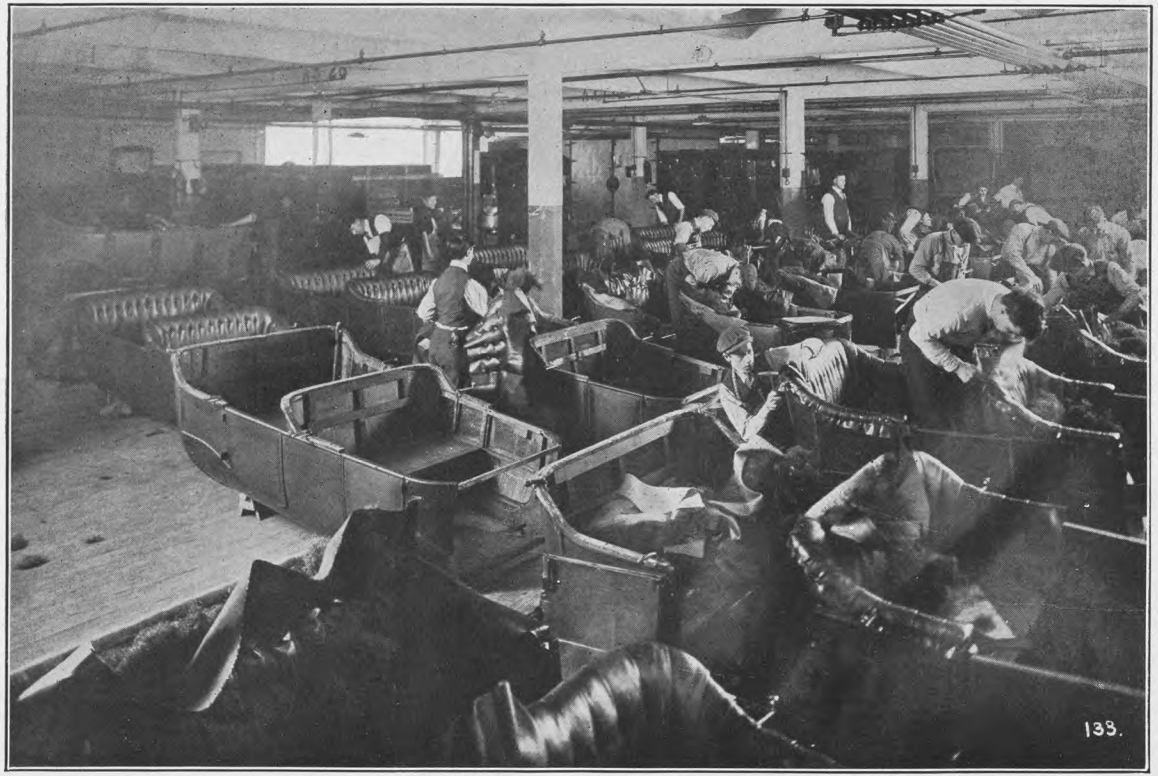

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PLATE XVII.—TRIM SHOP. PUTTING UPHOLSTERY ON BODIES.

Requirements.—Little special knowledge required. One employer preferred eighth-grade graduates; another required literacy only. Boys of 16 or 18 were sometimes employed, but the job required such strength and skill that not many minors were qualified.

Learning period.—One to three weeks; six weeks to three months to become proficient.

Sheet-metal bench jobber.[41]

Description of work.—A sheet-metal bench jobber does the general sheet-metal work for the factory and often belongs to the factory maintenance department. He must be an all-round sheet-metal worker and tinsmith, since his work is to make up from blue prints, drawings, or sketches the ventilating flues, eave troughs, and sheet-metal parts required about the factory. He lays out the work, cuts it, and puts it together, soldering the joints when necessary. In addition to doing bench work, he also may help to install the work.

Hazards or strains.—The sheet-metal jobber may receive slight cuts, scratches, or bruises from the sheet iron, and burns from hot solder. He is in danger of falling while installing work.

Requirements.—Ability to read blue prints and to do sheet-metal drafting, including triangulation.

Learning period.—A five years' apprenticeship was required in one factory visited.

THE PAINT SHOP.

Many metal products must be cleaned, painted, or varnished before shipment, and although this is not strictly metal work, in the automobile factories, the priming, rubbing, sanding, varnishing, enameling, and painting of the body form an important part of the factory process. Some of the work is done by dipping, some by spraying, some by hand painting. The hazards are those usually incident to using paint and varnish. In the factories visited 17 minors were employed as painters and 10 as dippers, sprayers, rubbers, or sanders.

THE TRIMMING AND THE TOP-MAKING DEPARTMENT.

In automobile and automobile-body factories producing a finished body the upholstered cushions, seats, and backs are made and put in place on the body in the trim shop. In such factories there is also a top-making department where tops are built over the bows and sockets. This work, while not belonging strictly to metal manufacturing, is a necessary part of automobile production. Forty-four girls and 60 boys were working as trimmers in the establishments included in the survey; 18 of the boys were working as bow coverers or top builders.

[41] For earnings, see Table 7, p. 16, where this occupation is classified under Sheet-metal workers.

THE INSPECTION DEPARTMENT.

WORK DONE.—In the inspection department parts are inspected to see that they are ready for use. In some factories, however, this work is done in each department as one of the last processes in the production of each part. Sometimes long forgings or tools are straightened in this department if inspection shows them not to be quite true.

INSPECTION-DEPARTMENT HAZARDS.—Relatively small, except for minor cuts and bruises in handling the material.

MINORS EMPLOYED.—While only 14 minors—all boys—were working as final inspectors, 213 boys and 83 girls were doing other kinds of inspection work.

Inspector.[42]

Description of work.—A simple kind of inspection work is illustrated by the work of a girl in one of the pressed-steel plants, whose duty it was to look over small sheet-metal parts and count them after they came from the shop and before they went to the stock room. The inspector sat at a bench with high board sides where the parts to be inspected were dumped. She passed the parts rapidly through her hands, counting the perfect ones and dropping them in a box, and throwing the culls on a pile of scrap.

Hazards or strains.—Only general factory hazards are involved. The work requires close attention and is monotonous. Some eyestrain.

Requirements.—The worker had to be able to count and to recognize flaws, cracks, or misshapen parts.

Learning period.—Generally one to two weeks; a month or six weeks to become proficient at simple kinds of inspection.

Body inspector.[42]

Description of work.—The body inspector in one establishment inspected thoroughly the automobile bodies which were bought outside. He first measured up the body with special gauges to see that all important points were located accurately. He then examined the woodwork inside to see that good material had been used and that all the screws were well put in. The outside was then inspected for dents or mars that could not be covered by paint. If below the required standard, the body was rejected and sent back. If it could be repaired in the factory, the inspector sent it to the body-repair department with a tag describing the defects.

Hazards or strains.—Only general factory hazards are involved.

Requirements.—This worker should be familiar with the specifications for the bodies he handles and have a knowledge of the wood and metal used in their construction.

Learning period.—Two weeks; six weeks to become proficient.

[42] For earnings, see Table 7, p. 16, where this occupation is classified under Inspectors—Other.

THE ASSEMBLY DEPARTMENT.

WORK DONE.—After parts are finished they must be assembled. In factories producing only simple parts no assembly is necessary, but in those producing a finished machine, automobile, or engine, assembly is likely to be one of the most important parts of the work. In one of the automobile factories visited practically all the parts of the car with the exception of the engine were purchased outside, and the factory was little more than a large assembly plant.

First is the work of subassembly, which consists of putting together small parts such as front axles, rear axles, transmissions, steering gear, governors, etc. The subassemblies are then put together to make the finished machine. In automobile factories the frame is put on a slowly moving conveyor and as the partly finished car moves past him each worker does one particular piece of work on it. Several departments may be organized for various kinds of assembly work—such as subassembly, engine erecting, outfit assembly, and final assembly.

ASSEMBLY-DEPARTMENT HAZARDS OR STRAINS.—Minor cuts and bruises.

MINORS EMPLOYED.—In all, 231 minors (196 boys and 35 girls) were working as assemblers; of these, 64 were motor, final, or outfit assemblers; 32 were body assemblers, and 135 were doing other kinds of assembly work.

ASSEMBLY-DEPARTMENT REQUIREMENTS.—Most of the employers interviewed preferred eighth-grade graduates; one specified seventh or eighth grade, and three did not require so much education. Though a few employed assemblers 16 years of age, most wanted boys or girls of 18 years or over. Experience as trucker, stock boy, or messenger is valuable.

Brake-band assembler.[44]

Description of work.—The work of a boy who was assembling automobile brake bands is illustrative of one of the simpler types of assembly. The brake band is a piece of band iron, about 2½ inches wide and one-eighth of an inch thick, in the shape of a circle about 14 inches inches in diameter. It is provided with small rivet holes, countersunk on the inside of the band. The brake-band lining fits around the outside of this brake band. The rivet holes are punched through the lining and copper rivets put in by a machine so constructed that a small plunger slipping down through the hole in the band cuts a corresponding hole in the lining; then the rivet comes up in place and is pressed through both holes. The entire operation took place as the operator held the band and lining together under the plunger of the machine and first pressed down on the foot lever and

[44] For earnings, see Table 7, p. 15, where this occupation is classified under Assemblers—Other.

then released it. About 12 rivets were put in each band. After the operator had put the rivets in several brake bands, he took them to the power-driven riveting machine, placed each rivet in turn on the center of the table of the machine, and pressed down on a foot lever. A small plunger, actuated by a cam, beat on the head of the rivet with blows in rapid succession, thus battering it down smooth. The time necessary for both operations on one brake band was about one minute.

Hazards or strains.—Hazard in this occupation is slight.

Requirements.—While the job is a simple one workers are preferred who have had experience as assemblers. (See also Assembly-department requirements.)

Learning period.—A month to become proficient.

Final assembler.[45]

Description of work.—One type of final assembly is illustrated by the work of an assembler in an automobile factory who was putting the wiring harnesses (wires for the electrical connections) in place on the chassis of the car and making the proper connections. The wires came to him already assembled, with terminal clips and with the flexible cable covering where necessary, so that all that was left for him to do was to put them in place, secure them to the frame with steel clips, and connect the terminal clips in their proper places.

Hazards or strains.—Little hazard involved.

Requirements.—See Assembly-department requirements.

Learning period.—A week to a month to become proficient.

Gasoline-engine erector.[45]

Description of work.—In one factory which produced gasoline engines for general utility work the assembly (or erection) of gasoline engines was done by two erectors working together. They first slipped the shafts of the subassemblies (the valve-lifting lever assembly, the timing-lever assembly, and the brake-latch assembly) into reamed holes in the engine base and secured them in place by set screws through the bosses which held them. They next attached the gas pipe with two cap screws and screwed the brass tube with its fitting into the base. A pipe plug was screwed into the opening for filling the base with gasoline. The exhaust to the muffler nipple was screwed into place. The connecting rod was bolted to the crank shaft, the carburetor put on, the priming apparatus screwed in place on the side of the cylinder, and the lubricator pipe, which oils the piston, screwed into the side of the cylinder. The cylinder was lifted

[45] For earnings, see Table 7, p. 15, where this occupation is classified under Assemblers—Motor, final, and outfit.

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PLATE XVIII.—TRIM SHOP, CUSHION-MAKING DEPARTMENT. BENCH WORK.

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PLATE XIX.—PISTON AND CONNECTING-ROD ASSEMBLY. BENCH WORK.

slightly while a cylinder flange gasket was inserted between the flanges of the cylinder and the base. The cylinder was then securely fastened to the base with four large cap screws. Next the breather was put on, two grease cups and the valves and valve cages screwed into place, and the hand-hole cover put on. After everything was assembled, the engine was tested for electrical contacts by means of wires from a storage battery. This completed the operation, which required about 1¾ hours.

Hazards or strains.—Minor accidents, such as bruises and scratches.

Requirements.—The workers had to know how to put the parts together and understand something of the working of the engine. Boys of 20 or over were preferred. (See also Assembly-department requirements.)

Learning period.—Several weeks; proficiency gained in three months.

Outfit assembler.[47]

Description of work.—The outfit assembler in the same factory was mounting a 3-horsepower stationary gasoline engine and a double-acting horizontal water force pump on a common base. He put the pump on the base in the proper position and marked the location of four pump bolt holes. He then took the pump off the base, put the base on a small truck, and hauled it to the drill press, where he drilled the bolt holes. Next he took the base back to his bench, set the pump in place again, and put in two of the bolts. Then he set the engine on the base in the proper location, lining it up in such a way that the connecting rod of the engine was in exact line with the piston rod of the pump and that the wrist pin on the back gears of the engine would be farthest from the pump when the piston rod of the pump was out to the end of the travel of the piston. He marked the location of the engine bolts in the base and also in the short sub-base which supported one side of the engine, and drilled the holes in both. After taking the base and sub-base back to the bench again, he bolted the pump and engine securely to them and babbitted the connecting-rod bearing on the wrist pin of the engine back gear. The time of the complete operation was 3½ hours.

Hazards or strains.—Bruises, scratches, and small cuts. Some hazard is involved in operating the drill press.

Requirements.—See Assembly-department requirements.

Learning period.—One week. One employer promoted factory stockmen or truckers to this job.

[47] For earnings, see Table 7, p. 15, where this occupation is classified under Assemblers—Motor, final, and outfit.

THE TESTING, ADJUSTMENT, AND FINAL-REPAIR DEPARTMENT.

WORK DONE.—In factories producing finished machines, each one is tested and inspected before shipment to see that all parts are in working order and that the necessary final adjustments and repairs have been made. In automobile factories the engine is tested before it is mounted on the frame and the car is tested after it is completely assembled.

MINORS EMPLOYED.—Thirty-eight minors were reported as testers, 14 as adjusters, and 97 as repair men. Some of the last may not have been doing final repair work; they may have been employed in other departments.

Rear-axle final adjuster.[48]

Description of work.—The work of the rear-axle final adjusters in one of the automobile factories visited was to adjust the rear axle drive pinion to the differential drive gear so that they would run as quietly and smoothly as possible under conditions varying from no load to full load. Two operators worked together, one to take care of the electric switchboard, the other to adjust the position of the drive pinion. In place of the rear wheels, the axle to be tested was provided with two pulleys, equal in diameter to the diameter of the tires used. Belts to run on these pulleys were suspended from pulleys on a shaft near the ceiling which was connected with an electric generator. The axle was driven by an electric motor through a propeller shaft and the transmission regularly used on that type of car, thus providing the same condition of drive as found on the finished automobile. The adjusters drew the rear axle over to the test rack on a small truck, slipped the drive belts on the axle pulleys, and swung the axle, supported by the belts, to the testing rack. They attached the propeller shaft to the transmission and clamped the axle securely in the rack. The switchboard man shifted the transmission gears into low speed by a lever and started the motor, running it slowly at first but gradually speeding it up. The man at the axle adjusted the gears at the place of smoothest running by tightening or loosening an adjusting collar with a wrench. The other worker then shifted the transmission to high speed and put a load on the ceiling generator by slowly turning on lamps which caused resistance in the circuit. As the speed and load increased, the second operator adjusted the drive pinion to the position of smoothest running for all conditions. The time of the complete operation was about 10 minutes.

Hazards or strains.—Slight hazard involved.

[48] For earnings, see Table 7, p. 16, where this occupation is classified under Machinists—Adjusters.

Requirements.—Preference is given to workers who have had experience in other kinds of assembly work. Eighth-grade graduates are preferred. Boys under 18 are too immature for the work.

Learning period.—One month to become proficient.

Brake and cable adjuster.[49]

Description of work.—The brake and cable adjuster in the same factory adjusted the brakes and the brake cables so as to get the proper pressure of the brake-band lining on the brake drum. On each end of the rear axle there are two shafts, one running through the inside of the other, which actuate the service and emergency brakes. Each shaft is controlled by a lever about 4 inches long. Four brake cables run from these levers to the brake-rack shaft levers, which are fastened to shafts on the center cross member of the frame, and from which one cable runs to the foot service-brake pedal and one to the emergency hand lever. It was the duty of the adjuster to set the adjustment on the brakes and also to adjust the length of the cables (which have adjustment blocks on one end) so that at the right time and at the proper pressure the brakes would respond to control through the foot service brake and the emergency hand lever.

Hazards or strains.—Little hazard involved. Since this work was done after the body had been put on the car it was necessary for the worker to get under the car to make the adjustments.

Requirements.—Similar to those for rear-axle adjusters.

Learning period.—One month to become proficient.

Tester.[50]

Description of work.—A tester in one plant was testing a stationary 3-horsepower gasoline engine and adjusting it to operate properly. The engines were brought from the erecting room into the testing room on a truck, lifted by means of a hoist to the test stand and bolted down. They were of the hopper cooling type, in which an open hopper is integral with the cylinder casting which holds the water for cooling the cylinder. The tester first screwed a spark plug in place and connected it with an electric current by attaching the two wires provided for the purpose. He revolved the shaft of the engine several times, watching closely and adjusting until good electrical contacts were made. He then oiled the engine thoroughly and cranked it for starting. At first the engine coughed and snorted when cranked but did not go of itself. The tester adjusted the carburetor and cranked again; the engine ran, but not smoothly. He again adjusted the carburetor and made adjustments in the governor regulator until the engine ran very smoothly. The water hopper was then filled with water and the engine allowed to run for

[49] For earnings, see Table 7, p. 16, where this occupation is classified under Machinists—Adjusters.

[50] For earnings, see Table 7, p. 16, where this occupation is classified under Machinists—Testers.

several hours. The tester examined it occasionally to see that it did not heat excessively.

Hazards or strains.—Testers were liable to injury to wrists when cranking the engine. They also breathed fumes all day from the engine exhaust pipes. The test room was provided with an exhaust system made up of pipes running under the floor from all the test stands to a large motor-driven suction fan which drew the exhaust gas from the engines and forced it up through a large smokestack, but while this system was good, many of the engines were not connected with it and were exhausting into the room. It required several minutes to become accustomed to the fumes so that one could remain without feeling stifled in this room where about 200 engines, ranging from 3 to 12 horsepower, were being tested.

Requirements.—Most employers considered this a skilled job and preferred eighth-grade graduates. A thorough knowledge of the principles and methods of operating gasoline engines was necessary, as well as some knowledge of electricity.

Learning period.—The employer in this factory, as well as those in the automobile factories visited, estimated that it might take from six months to a year for a tester to attain proficiency.

Motor-block tester.[51]

Description of work.—The motor-block tester observed in an automobile factory ran the engine before it was mounted on the chassis, in order to wear its bearings down smooth and test it for defects that might appear under conditions of load. The motor was brought in on a special truck from the motor-assembling department and slid from the truck directly to the test frame. The worker bolted the motor securely in place, connected the drive coupling between the engine and the electric generator, attached the water-inlet and outlet hoses, which supplied water to the engine for cooling, and bolted on the intake manifold connected with the gas supply. The engine was first run by the electric motor, the tester throwing a switch on the switchboard to start it. He regulated the speed of the electric motor by turning the pointer of a field rheostat on the switchboard, starting the engine slowly and gradually increasing the speed, in order that bearings or moving parts which fitted too tightly might not heat up excessively. After about 45 minutes he turned on the gas and started the engine, throwing out the electric motor switch and throwing in another, which caused the engine to drive the motor as a generator. More load was put on the generator from time to time until the engine was pulling full load. The tester watched the engine closely for excessive heating of the bearings or cylinders, noisy drive gears,

[51] For earnings, see Table 7, p. 16, where this occupation is classified under Machinists—Testers.

leaky crank case or leaky inlet or outlet castings, undue vibration caused by unbalanced flywheel, or other evidence of defects.

Hazards or strains.—The testing room was filled with gas from the engine exhaust pipes and was very noisy on account of the incessant explosions.

Requirements.—This worker should have a common-school education and must know the construction and principles of operation of an automobile motor.

Learning period.—About three months; four months to become proficient.

Final-test driver.[52]

Description of work.—The work of the final-test driver in one of the automobile factories visited was to drive the car around the city for the purpose of finding any defect in it. If he found no defects, he put a card on the car marked "O. K." If there were any faults, he specified them on a card and sent the car back to the final-repair department. The following are some of the defects which the final tester might discover: Noisy differential gears; noisy transmission gears; knock in the engine; heating up of the engine; carburetor out of adjustment; brakes not properly adjusted.

Hazards or strain.—The hazard is that incident to driving an untried car in the city streets.

Requirements.—Most employers considered this a skilled job and preferred eighth-grade graduates. Knowledge of the construction and operation of the car is necessary, together with ability to detect the different sounds and actions of the running car and recognize their meaning.

Learning period.—Three months; a year to become proficient.

Rear-axle repair man.[53]

Description of work.—The rear-axle repair man in an automobile factory had the work of repairing axles just assembled or being assembled in which defects were discovered. For example, the assembler might find the brake-band pin too short; the axle inspector, when the assembled axle reached him, might discover a lock washer or some other part missing; or the final tester might find gears that were unusually noisy. In all such cases the axle would be sent to the repair department. The repair man had to be so familiar with the construction of the axle that he could tear down any part and rebuild it.

Hazards or strains.—Only general factory hazards are involved.

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[52] For earnings, see Table 7, p. 16, where this occupation is classified under Machinists—Testers.

[53] For earnings, see Table 7, p. 16, where this occupation is classified under Machinists—Repair.

Requirements.—One employer required merely a sixth-grade education; others preferred eighth grade. Only boys 18 or over were employed. Any shop training or experience was considered valuable.

Learning period.—Six months; 10 months to become proficient.

Automobile-motor repair man.[54]

Description of work.—If in the final-testing department any defect is found in a motor which can not easily be remedied there, the motor is sent to the motor-repair department to be put in order. The repair man must be able to tear down and reassemble the whole or any part of the motor and to repair or replace any defective part. If a part is beyond repair, it is taken out and a new one put in its place. The worker may find it necessary to repair parts such as the following: Scored crank shaft and connecting-rod bearings; stripped cam gears and pump gears; scored piston and cylinder; noisy drive gears; cracked crank case; sprung cam shaft; unbalanced flywheel; leaky water outlet and inlet castings.

Hazards or strains.—Minor injuries such as bruises, scratches, or cuts on the hands.

Requirements.—Some knowledge of mechanical work and of the handling and use of tools. Thorough knowledge of the assembly of the automobile motor.

Learning period.—Six months; a year to become proficient.

Final general car repairer.[54]

Description of work.—As the car moves down the final-assembly line some processes through oversight in rapid working may be left undone, some parts through carelessness may not be put together correctly, or there may be a flaw in some part that was not noticed by the man who attached it. At the end of the line the car is given a thorough inspection, and if it does not pass this inspection a red tag stating the trouble is attached to it and it is sent to the final-repair department. It is the final-repair man's work to find the cause of the trouble, make the necessary repairs, and turn in the card with his signature. The following are some of the troubles found: Fender bolts loose or lacking; body bolts out because holes in body and frame do not line up; defective wiring such as wrong or loose connections, etc.; hood not fitting properly; gasoline tank leaking; ventilating fan striking.

Hazards or strains.—Risk of pounding, scratching, and cutting hands.

Requirements.—Some knowledge of the construction of the car.

Learning period.—Three to 6 months; 6 to 10 months to become proficient.

[54] For earnings, see Table 7, p. 16, where this occupation is classified under Machinists—Repair.

OTHER DEPARTMENTS.

The receiving department, where material for use in the factory is received and checked in; the stock room, where material is stored ready for use; the tool crib, where tools are kept to be given out to the workmen, and the shipping department, while not strictly production departments, are necessary parts of the factory organization. About one-tenth of all the minors (270 boys and 18 girls) were working in the stock rooms and tool cribs. In two factories the stock room was considered especially dangerous because of the many accidents occurring from falling stock. The safety engineer in one establishment said that such accidents should be obviated by careful piling of stock and special care in handling.

Maintenance departments were sometimes organized to attend to the proper upkeep of the factory. Carpenters, electricians, millwrights, oilers, tinners, pipe fitters, and other workers were sent from this department to any part of the factory when they were needed. These occupations were so highly skilled that few minors were employed.

Truckers, drivers, and messengers might be found in any department. In the factories surveyed, 202 minors were truckers and drivers and 14 were messengers.

Stock-room man.[56]

Description of work.—In one establishment when an order for parts came into the stock room, the stock-room foreman made out a list called a "pick-up sheet," giving the symbols of each part required. He gave this sheet to a stock-room man, whose duty it was to fill the order as completely as possible, leaving the missing parts unchecked on the sheet. The foreman recorded these parts on a "shortage card" which he sent to the stock chaser. The stock man also put new stock into the bins.

Hazards or strains.—Some danger of falling while climbing from one bin to another.

Requirements.—This worker must be able to memorize symbols of parts, and must use care in putting stock into the bins and taking it from them.

Learning period.—About one day; one month to one year to become proficient.

Stock chaser.[57]

Description of work.—The stock chaser in one establishment visited had to see that raw stock was moved to the machine shop as rapidly

[56] For earnings, see Table 7, p. 16, where this occupation is classified under Stock and tool-crib workers—Other.

[57] For earnings, see Table 7, p. 16, where this occupation is classified under Stock and tool-crib workers—Stock chaser.

as needed; that work was moved from one machine to another; that finished work was taken to the stock room and that stock from the stock room was moved to the erecting department as fast as it was needed. In other words it was his work to see that everyone had at hand sufficient stock with which to proceed. If an order came into the stock room and there was not enough stock in the department to fill it, all on hand was sent and a "shortage card," showing the parts lacking, was made out for the stock chaser; it then became his business to see that this stock reached the erecting department as soon as possible.

Hazards or strains.—The work involves general factory hazards.

Requirements.—The stock chaser should know the location of all stock, machines, and departments, and should know how the work is routed through the shop. Most employers preferred applicants who had at least an eighth-grade education.

Learning period.—One day to one month; three months to one year to become proficient.

Electric trucker.[58]

Description of work.—The work of an electric trucker in one establishment was to haul loads of stock from one department to another. The stock was loaded onto trucks by truck fillers and unloaded by laborers. When the trucks were loaded, from one to five were connected and attached to the electric truck. In operating this truck the driver stood on a ledge on the front, changing the speed by use of a foot lever and steering with a hand tiller. Many different forms of trucks are used.

Hazards or strains.—Some danger of accident from collision while driving the truck through the factory.

Requirements.—Not much education is necessary. The trucker must be familiar with the location of the departments served and able to drive and control the electric truck.

Learning period.—About a day; one week or less to gain proficiency.

Messenger.[59]

Description of work.—The messenger or bell-hop in the bench-work department of the tool room of one of the automobile factories surveyed carried notes, small tools, etc., from the tool room to other departments of the shop and cleaned up the machines in the tool bench-work department for about two hours on Saturday forenoons.

Hazards or strains.—Only general factory hazards.

[58] For earnings, see Table 7, p. 16, where this occupation is classified under Laborers and helpers—Truckers.

[59] For earnings, see Table 7, p. 16, where this occupation is classified under Laborers and helpers—Messengers.

Requirements.—Sixth or eighth grade education required. The worker must know the location of different departments in the factory.

Learning period.—One hour; proficiency gained in one week.

Oiler.[60]

Description of work.—The work of the oiler in an automobile factory was to oil the bearings of the countershafts for driving machines every day and to fill the grease cups on the main-line shafts once every three weeks. Since the countershafts were located just under the ceiling, it was necessary for the oiler to use a ladder to reach them. Each oiler was given a section of the factory, which would furnish enough work to keep him busy for the day, and each day he went over this ground. He poured the oil into the bearing boxes from a long-spouted oil can and put the hard grease in the grease cups with a wooden paddle.

Hazards or strains.—Danger from falling against or touching the moving machinery.

Requirements.—Boys of at least 18 were usually preferred. Only two employers required an eighth-grade education; the others made no educational requirement.

Learning period.—A few days to one month to become proficient.

[60] For earnings, see Table 7, p. 16, where this occupation is classified under Oilers.

APPENDIX II.—FORMS USED IN THE SURVEY.

FORM 1.—*Form used to secure information from employment managers concerning occupations.*

[Size: 10½ by 8 inches.]

U. S. DEPARTMENT OF LABOR
CHILDREN'S BUREAU

Ind. ..... Estab. ..... Occup. .....

1. Requirements for admission to occupation: .....

(*a*) Sex: ..... Why? .....

(*b*) Age: M. ..... F. ..... Why? .....

(*c*) Physical: .....

(*d*) Mental: .....

(*e*) Character: .....

(*f*) Schooling: (1) General, N. .....

(2) Vocational, N. .....

(*g*) Shop training or experience, N. .....

(1) Apprenticeship, N. .....

(2) Factory school, N. .....

(3) Experience in other occupation, N. .....

2. Previous training and experience employer considers desirable if obtainable: ....

.....

3. Method of training for occupation in plant: .....

.....

4. Length of time takes average worker: (*a*) To learn job..... (*b*) To become proficient at job..... (*c*) To earn maximum wage .....

5. Apprenticeship system, N. (*a*) Length..... (*b*) Sex..... (*c*) Age....

(*d*) Wage: .....

(*e*) Training: .....

.....

6. Usual line of promotion: .....

(*a*) Training necessary for promotion.....

(*b*) How necessary training can be secured.....

7. Turnover: .....

.....

8. Hazard: N. (*a*) from disease, N. .....

(*b*) Accident, N. .....

(*c*) Safety appliances, N. .....

....

(Agent.) (Date.) (Informant.)

FORM 2.—*Questionnaire.*

(FACE.)

INDUSTRY

OCCUPATION

U. S. DEPARTMENT OF LABOR
CHILDREN'S BUREAU

FACTORY

DEPT.

Kindly answer the following questions as soon as possible, and return this card in the attached envelope to the factory office, where it will be called for by a representative of the United States Department of Labor.

The information furnished by you will be used only for the purpose of showing the kind of work persons under 21 are doing in your industry, and will be regarded as strictly confidential.

Do not write in this space.

1. Name? ..... 2. Address? ..... 3. Sex? ..... 4. Age? .....
5. In what country were you born? ..... What State? ..... What town? .....
6. In what country was your father born? ..... 7. What was his trade? .....
8. At what age did you stop going regularly to day school? ..... years.
9. What grade had you finished? .....
10. In what town or county did you last go regularly to day school? ..... Name of school? ....
11. Did you have any trade training in day school? ..... 12. If so, state courses and length of each: .....
13. At what age did you go to work? ..... years. 14. How long have you worked in the ..... industry?
15. What particular kind of work are you now doing? .....
16. How long have you done this kind of work (including apprenticeship)? .....
17. How did you learn to do this kind of work? .....
18. How long did it take you to learn? .....
19. Have you ever served a regular apprenticeship? ..... How long? ..... What trade? ....
20. Have you ever taken any trade training courses since leaving school? ..... If so, please state what kind, how long, and where given: .....

(OVER)

(REVERSE.)

21. Please list below all the positions you have held since first going to work, beginning with the first, and stating the kind of work done, the length of time employed, and the wages received:

POSITION.	NAME OF FIRM.	BUSINESS.	WHAT WAS YOUR JOB.	DATE OF BEGINNING WORK.	TIME EMPLOYED.	AVERAGE WEEKLY WAGE.
1st						
2d						
3d						
4th						
5th						
6th						

22. Did you ever have any accidents while working at your present trade? ..... If so, please state the nature of each accident, the number of weeks it kept you away from work, the date of the accident, and whether or not you received any compensation: .....

Do not write in this space.

(OVER)

APPENDIX III.—GENERAL TABLES.

GENERAL TABLE I.—*Proportion of minor employees, by occupation and industry; employees in metal-manufacturing industries.*

Occupation.	Employees in metal-manufacturing industries.																	
	Total.	Adult.	Minor.		Industry.													
					Automobile.				Automobile parts.				Foundry and machine shop.				Other.			
					Total.	Adult.	Minor.		Total.	Adult	Minor.		Total.	Adult	Minor.		Total	Adult	Minor.	
			Number.	Per cent.			Number.	Per cent.[1]			Number.	Per cent.[1]			Number.	Per cent.[1]			Number.	Per cent.[1]
Total	26,192	23,412	[2] 2,780	10.6	14,455	12,919	1,536	10.6	4,068	3,697	371	9.1	4,724	4,164	560	11.9	2,945	2,632	313	10.6
Apprentices	606	414	192	31.7	241	161	80	33.2	169	142	27	16.0	189	108	81	42.9	7	3	4	.....
Assemblers	2,095	1,877	218	10.4	1,551	1,415	136	8.8	224	209	15	6.7	194	168	26	13.4	126	85	41	32.5
Inspectors	2,088	1,778	310	14.8	1,519	1,292	227	14.9	369	331	38	10.3	96	69	27	.....	104	86	18	17.3
Laborers and helpers	4,833	4,251	582	12.0	1,802	1,521	281	15.6	830	746	84	10.1	1,510	1,364	146	9.7	691	620	71	10.3
Foundry and core room	475	370	105	22.1	73	72	1	.....	10	10	.....	.....	355	265	90	25.4	37	23	14	.....
Truckers and drivers	1,126	925	201	17.9	650	502	148	22.8	255	217	38	14.9	174	165	9	5.2	47	41	6	.....
Other	3,232	2,956	276	8.5	1,079	947	132	12.2	565	519	46	8.1	981	934	47	4.8	607	556	51	8.4
Machine operators	5,882	5,287	595	10.1	3,461	3,169	292	8.4	1,057	967	90	8.5	843	701	142	16.8	521	450	71	13.6
Drills	1,272	1,149	123	9.7	847	785	62	7.3	296	267	29	9.8	69	48	21	.....	60	49	11	.....
Grinders	1,100	1,005	95	8.6	722	664	58	8.0	167	152	15	9.0	184	165	19	10.3	27	24	3	.....
Milling	476	387	89	18.7	265	233	32	12.1	95	84	11	.....	95	54	41	.....	21	16	5	.....
Lathe	885	787	98	11.1	455	420	35	7.7	144	130	14	9.7	156	124	32	20.5	130	113	17	13.1
Other	2,149	1,959	190	8.8	1,172	1,067	105	9.0	355	334	21	5.9	339	310	29	8.6	283	248	35	12.4
Skilled workers	5,792	5,499	293	5.1	3,237	3,060	177	5.5	709	666	43	6.1	1,223	1,174	49	4.0	623	599	24	3.9
Machinists, testers, and repairers	2,385	2,224	161	6.8	1,531	1,414	117	7.6	305	294	11	3.6	336	317	19	5.7	213	199	14	6.6
Other metal[3]	2,655	2,550	105	4.0	1,014	976	38	3.7	383	351	32	8.4	862	836	26	3.0	396	387	9	2.3
Painters	752	725	27	3.6	692	670	22	3.2	21	21	.....	.....	25	21	4	.....	14	13	1	.....
Stock and tool-crib workers	1,057	769	288	27.2	703	513	190	27.0	208	159	49	23.6	110	76	34	30.9	36	21	15	.....
Other occupations	3,839	3,537	302	7.9	1,941	1,788	153	7.9	502	477	25	5.0	559	504	55	9.8	837	768	69	8.2
Core makers	182	151	31	17.0	.....	.....	.....	.....	.....	.....	.....	.....	154	127	27	17.5	28	24	4	.....
Trimmers	574	473	101	17.6	563	464	99	17.6	10	8	2	.....	.....	.....	.....	.....	1	1	.....	.....
Miscellaneous[4]	3,083	2,913	170	5.5	1,378	1,324	54	3.9	492	469	23	4.7	405	377	28	6.9	808	743	65	8.0

[1] Not shown where base is less than 100.

[2] Excluding minors in two factories in which information for adult workers could not be secured.

[3] Skilled—Other metal: Sheet metal panelers; sheet metal layout; sheet metal, other; molders; blacksmiths; boiler makers; welders; heat treat; furnacemen, heaters, ladlers, and pourers; millwrights; pattern makers; template makers; chemists; draftsmen and designers; engineers; toolmaker; foreman (superintendent); pyrometer reader.

[4] Other—Miscellaneous: Filers; polishers and buffers; finishers; riveters; straighteners; oilers; benchworkers; picklers; miscellaneous.

GENERAL TABLE II.—*Occupation, by age; minors in metal-manufacturing industries.*

Occupation.	Minors in metal-manufacturing industries.													
	Total.		Age.											
			14 years, under 15.[1]	15 years, under 16.[1]	16 years, under 17.		17 years, under 18.		18 years, under 19.		19 years, under 20.		20 years, under 21.		Not reported.[1]
	Number.	Per cent distribution.			Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.	
Total	2,840	100.0	5	20	114	100.0	198	100.0	663	100.0	903	100.0	935	100.0	2
Apprentices	196	6.9	.....	5	22	19.3	36	18.2	46	6.9	37	4.1	50	5.3	.....
Assemblers	231	8.1	1	.....	9	7.9	15	7.6	41	6.2	73	8.1	92	9.8	.....
Inspectors	310	10.9	.....	.....	10	8.8	21	10.6	81	12.2	95	10.5	103	11.0	.....
Laborers and helpers	586	20.6	2	6	23	20.2	41	20.7	162	24.4	191	21.2	161	17.2	.....
Machine operators	619	21.8	1	2	15	13.2	27	13.6	122	18.4	214	23.7	237	25.3	1
Drills	123	4.3	.....	.....	1	.9	6	3.0	20	3.0	48	5.3	48	5.1	.....
Grinders	99	3.5	.....	1	1	.9	1	.5	18	2.7	32	3.5	46	4.9	.....
Lathe	98	3.5	.....	.....	2	1.8	4	2.0	22	3.3	30	3.3	40	4.3	.....
Milling	89	3.1	.....	.....	1	.9	10	5.1	20	3.0	32	3.5	26	2.8	.....
Other	210	7.4	1	1	10	8.8	6	3.0	42	6.3	72	8.0	77	8.2	1
Stock and tool-crib workers	288	10.1	1	3	15	13.2	34	17.2	72	10.9	87	9.6	76	8.1	.....
All other	610	21.5	.....	4	20	17.5	24	12.1	139	21.0	206	22.8	216	23.1	1

[1] Per cent distribution not shown where base is less than 100.

GENERAL TABLE III.—*Nativity and country of birth of father, by nativity of child; minors in metal-manufacturing industries.*[1]

Nativity and country of birth of father.	Minors in metal-manufacturing industries.[1]					
	Total.		Native.		Foreign born.	
	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.
Total	[2] 292	100.0	172	100.0	120	100.0
Native	3	1.0	.....	.....	3	2.5
Foreign born	289	99	172	100.0	117	97.5
Canada	58	19.9	40	23.3	18	15.0
Germany	52	17.8	45	26.2	7	5.8
United Kingdom	43	14.7	15	8.7	28	23.3
Poland	34	11.6	25	14.5	9	7.5
Austria-Hungary	31	10.6	15	8.7	16	13.3
Russia	19	6.5	12	7.0	7	5.8
Italy	13	4.5	3	1.7	10	8.3
Scandinavia	11	3.8	11	6.4	.....	.....
France	5	1.7	3	1.7	2	1.7
All other	23	7.9	3	1.7	20	16.7

[1] Questionnaire group.

[2] Information as to country of birth of father not secured for 621 minors.

GENERAL TABLE IV.—*Number of hours worked per week, by age and sex; minors in metal-manufacturing industries.*

Number of hours worked per week, and sex.	Minors in metal-manufacturing industries.														
	Total.		Age.												
			14 years, under 15.[1]	15 years, under 16.[1]	16 years, under 17.		17 years, under 18.		18 years, under 19.		19 years, under 20.		20 years, under 21.		Not reported.[1]
	Number.	Per cent distribution.			Number.	Per cent distribution.[1]	Number.	Per cent distribution.[1]	Number.	Per cent distribution.[1]	Number.	Per cent distribution.[1]	Number.	Per cent distribution.[1]	
Total	2,840	100.0	5	20	114	100.0	198	100.0	663	100.0	903	100.0	935	100.0	2
Less than 36 hours	478	16.8	2	7	21	18.4	27	13.6	102	15.4	156	17.3	163	17.4	.....
36 hours, less than 39	111	3.9	.....	.....	3	2.6	3	1.5	26	3.9	40	4.4	39	4.2	.....
39 hours, less than 42	174	6.1	.....	1	4	3.5	15	7.6	36	5.4	53	5.9	65	7.0	.....
42 hours, less than 45	251	8.8	.....	.....	7	6.1	15	7.6	64	9.7	87	9.6	78	8.3	.....
45 hours, less than 48	340	12.0	.....	2	10	8.8	31	15.7	95	14.3	106	11.7	96	10.3	.....
48 hours, less than 51	380	13.4	.....	3	16	14.0	38	19.2	82	12.4	113	12.5	127	13.6	1
51 hours, less than 54	127	4.5	.....	.....	9	7.9	15	7.6	32	4.8	34	3.8	37	4.0	.....
54 hours	22	.8	.....	.....	.....	.....	2	1.0	3	.5	9	1.0	8	.9	.....
Over 54 hours, less than 57	113	4.0	.....	.....	8	7.0	6	3.0	32	4.8	37	4.1	30	3.2	.....
57 hours, less than 60	59	2.1	.....	.....	1	.9	6	3.0	11	1.7	23	2.5	18	1.9	.....
60 hours and over	157	5.5	.....	.....	5	4.4	8	4.0	28	4.2	53	5.9	63	6.7	.....
Not on pay roll and not reported	[2] 628	22.1	3	7	30	26.3	32	16.2	152	22.9	192	21.3	211	22.6	1
Boys	2,536	100.0	5	19	108	100.0	171	100.0	562	100.0	809	100.0	860	100.0	2
Less than 36 hours	423	16.7	2	7	20	18.5	25	14.6	84	14.9	132	16.3	153	17.8	.....
36 hours, less than 39	98	3.9	.....	.....	3	2.8	3	1.8	24	4.3	32	4.0	36	4.2	.....
39 hours, less than 42	146	5.8	.....	1	4	3.7	9	5.3	25	4.4	48	5.9	59	6.9	.....
42 hours, less than 45	204	8.0	.....	.....	6	5.6	12	7.0	52	9.3	69	8.5	65	7.6	.....
45 hours, less than 48	301	11.9	.....	1	10	9.3	27	15.8	81	14.4	95	11.7	87	10.1	.....
48 hours, less than 51	342	13.5	.....	3	15	13.9	36	21.1	70	12.5	102	12.6	115	13.4	1
51 hours, less than 54	111	4.4	.....	.....	7	6.5	11	6.4	28	5.0	31	3.8	34	4.0	.....
54 hours	17	.7	.....	.....	.....	.....	1	.6	2	.4	8	1.0	6	.7	.....
Over 54 hours, less than 57	102	4.0	.....	.....	8	7.4	6	3.5	23	4.1	35	4.3	30	3.5	.....
57 hours, less than 60	58	2.3	.....	.....	1	.9	6	3.5	11	2.0	22	2.7	18	2.1	.....
60 hours and over	155	6.1	.....	.....	4	3.7	7	4.1	28	5.0	53	6.6	63	7.3	.....
Not on pay roll and not reported	[2] 579	22.8	3	7	30	27.8	28	16.4	134	23.8	182	22.5	194	22.6	1

Girls	304	100.0		1	6		27		101	100.0	94		75	
Less than 36 hours	55	18.1			1		2		18	17.8	24		10	
36 hours, less than 39	13	4.3							2	2.0	8		3	
39 hours, less than 42	28	9.2					6		11	10.9	5		6	
42 hours, less than 45	47	15.5			1		3		12	11.9	18		13	
45 hours, less than 48	39	12.8		1			4		14	13.9	11		9	
48 hours, less than 51	38	12.5			1		2		12	11.9	11		12	
51 hours, less than 54	16	5.3			2		4		4	4.0	3		3	
54 hours	5	1.6					1		1	1.0	1		2	
Over 54 hours, less than 57	11	3.6							9	8.9	2			
57 hours, less than 60	1	.3									1			
60 hours and over	2	.7			1		1							
Not on pay roll and not reported	[2] 49	16.1					4		18	17.8	10		17	

[1] Per cent distribution not shown where base is less than 100.
[2] Includes 619 minors (572 boys and 47 girls) whose names did not appear on pay roll and 9 minors (7 boys and 2 girls) for whom number of hours per week was not reported.

GENERAL TABLE V.—*Number of hours worked per week, by method of payment; minors in metal-manufacturing industries.*[1]

Number of hours worked per week.	Minors in metal-manufacturing industries.[1]							
	Total.		Method of payment.					
			Time.		Piece.		Not reported.	
	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.
Total	913	100.0	489	100.0	304	100.0	120	100.0
Less than 36 hours	127	13.9	80	16.4	47	15.5	.....	.....
36 hours, less than 39	35	3.8	22	4.5	13	4.3	.....	.....
39 hours, less than 42	64	7.0	39	8.0	25	8.2	.....	.....
42 hours, less than 45	89	9.7	53	10.8	36	11.8	.....	.....
45 hours, less than 48	130	14.2	92	18.8	38	12.5	.....	.....
48 hours, less than 51	140	15.3	103	21.1	37	12.2	.....	.....
51 hours, less than 54	52	5.7	28	5.7	24	7.9	.....	.....
54 hours	10	1.1	5	1.0	5	1.6	.....	.....
Over 54 hours, less than 57	38	4.2	27	5.5	11	3.6	.....	.....
57 hours, less than 60	32	3.5	16	3.3	15	4.9	1	0.8
60 hours and over	76	8.3	24	4.9	52	17.1	.....	.....
Not reported	120	13.1	.....	.....	1	.3	119	99.2

[1] Questionnaire group.

GENERAL TABLE VI.—*Earnings per week, by sex; minors in metal-manufacturing industries.*[1]

Earnings per week.	Minors in metal-manufacturing industries.[1]					
	Total.		Boys.		Girls.	
	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.
Total	913	.....	818	.....	95	.....
Total reporting	793	100.0	704	100.0	89	100.0
Less than $5	18	2.3	15	2.1	3	3.4
$5, less than $10	24	3.0	18	2.6	6	6.7
$10, less than $15	44	5.5	31	4.4	13	14.6
$15, less than $20	73	9.2	38	5.4	35	39.3
$20, less than $25	112	14.1	95	13.5	17	19.1
$25, less than $30	149	18.8	142	20.2	7	7.9
$30, less than $35	135	17.0	129	18.3	6	6.7
$35, less than $40	91	11.5	90	12.8	1	1.1
$40, less than $45	70	8.8	69	9.8	1	1.1
$45, less than $50	28	3.5	28	4.0	.....	.....
$50, less than $55	16	2.0	16	2.3	.....	.....
$55, less than $60	12	1.5	12	1.7	.....	.....
$60, less than $65	8	1.0	8	1.1	.....	.....
$65, less than $70	3	.4	3	.4	.....	.....
$70, less than $75	5	.6	5	.7	.....	.....
$75 and over	5	.6	5	.7	.....	.....
Not reported	120	.....	114	.....	6	.....

[1] Questionnaire group.

GENERAL TABLE VII.—*Earnings per week, by number of hours per week; minors in metal-manufacturing industries.*

Number of hours worked per week.	Minors in metal-manufacturing industries—									
	Total.	Reporting earnings per week.								
		Total reporting.	Less than $5.		$5, less than $10.		$10, less than $15.		$15, less than $20.	
			Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.[1]
Total	2,840	2,191	82	3.7	109	5.0	170	7.8	238	10.9
Total reporting	2,212	2,182	82	3.8	109	5.0	170	7.8	235	10.8
Less than 36 hours	478	477	82	17.2	108	22.6	110	23.1	82	17.2
36 hours, less than 39	111	111	.....	.....	1	.9	9	8.1	23	20.7
39 hours, less than 42	174	174	.....	.....	.....	.....	12	6.9	22	12.6
42 hours, less than 45	251	251	.....	.....	.....	.....	24	9.6	28	11.2
45 hours, less than 48	340	331	.....	.....	.....	.....	11	3.3	33	10.0
48 hours, less than 51	380	361	.....	.....	.....	.....	3	.8	40	11.1
51 hours, less than 54	127	127	.....	.....	.....	.....	1	.8	4	3.1
54 hours	22	22	.....	.....	.....	.....	.....	.....	3	.....
Over 54 hours, less than 57	113	113	.....	.....	.....	.....	.....	.....	.....	.....
57 hours, less than 60	59	59	.....	.....	.....	.....	.....	.....	.....	.....
60 hours and over	157	156	.....	.....	.....	.....	.....	.....	.....	.....
Not on pay roll and not reported	[3] 628	9	.....	.....	.....	.....	.....	.....	3	.....

Number of hours worked per week.	Minors in metal-manufacturing industries—								
	Reporting earnings per week.								Not on pay roll and not reported.
	$20, less than $25.		$25, less than $30.		$30, less than $35.		$35 and over.		
	Number.	Per cent.	Number.	Per cent.[1]	Number.	Per cent.[1]	Number.	Per cent.[1]	
Total	334	15.2	423	19.3	339	15.5	496	22.6	[2] 649
Total reporting	333	15.3	423	19.4	338	15.5	492	22.5	30
Less than 36 hours	49	10.3	24	5.0	7	1.5	15	3.1	1
36 hours, less than 39	34	30.6	15	13.5	18	16.2	11	9.9	.....
39 hours, less than 42	45	25.9	42	24.1	26	14.9	27	15.5	.....
42 hours, less than 45	60	23.9	60	23.9	27	10.8	52	20.7	.....
45 hours, less than 48	71	21.5	100	30.2	47	14.2	69	20.8	9
48 hours, less than 51	51	14.1	119	33.0	78	21.6	70	19.4	19
51 hours, less than 54	10	7.9	30	23.6	40	31.5	42	33.1	.....
54 hours	.....	.....	4	.....	9	.....	6	.....	.....
Over 54 hours, less than 57	12	10.6	25	22.1	41	36.3	35	31.0	.....
57 hours, less than 60	.....	.....	2	.....	19	.....	38	.....	.....
60 hours and over	1	.6	2	1.3	26	16.7	127	81.4	1
Not on pay roll and not reported	1	.....	.....	.....	1	.....	4	.....	619

[1] Not shown where base is less than 100.
[2] Includes 619 minors whose names did not appear on pay roll and 30 whose earnings per week were not reported.
[3] Includes 619 minors whose names did not appear on pay roll and 9 for whom number of hours per week was not reported.

GENERAL TABLE VIII.—*Occupation and industry of father; minors in metal-manufacturing industries.*[1]

Occupation and industry of father.	Minors in metal-manufacturing industries.[1]		Occupation and industry of father.	Minors in metal-manufacturing industries.[1]	
	Number.	Per cent distribution.		Number.	Per cent distribution.
Total	913	100.0	Manufacturing and mechanical—Continued.		
Agriculture, forestry, and animal husbandry	208	22.8	Laborers	78	8.5
Extraction of minerals	46	5.0	Other metal	5	.5
Manufacturing and mechanical	402	44.0	Other manufacturing and mechanical	94	10.3
Building trades	112	12.3	Transportation	41	4.5
Iron and steel	113	12.4	Trade	49	5.4
Blacksmiths, forgemen, and hammer men	27	3.0	Public service	10	1.1
Molders, founders, and casters	18	2.0	Professional service	19	2.1
Machinists, millwrights, and toolmakers	40	4.4	Domestic and personal service	8	.9
Other	28	3.1	Clerical	12	1.3
			No occupation and not reported	118	12.9

[1] Questionnaire group.

GENERAL TABLE IX.—*Location of school last attended, by grade completed; minors in metal-manufacturing industries.*[1]

Grade completed.	Minors in metal-manufacturing industries—[1]										
	Total.	Who last attended school in Michigan.									
		Total.		Michigan city in which working.		Other Michigan city.		Michigan rural.		Michigan, not reported whether city or rural.	
		Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Total	913	528	57.8	286	31.3	199	21.8	25	2.7	18	2.0
Sixth and lower grades	131	57	43.5	38	29.0	16	12.2	.....	.....	3	2.3
Seventh grade	144	90	62.5	60	41.7	24	16.7	2	1.4	4	2.8
Eighth grade	335	207	61.8	112	33.4	64	19.1	20	6.0	11	3.3
First year high school	107	72	57.3	38	35.5	32	29.9	2	1.9	.....	.....
Second and third year high school	119	70	58.8	27	22.7	42	35.3	1	.8	.....	.....
Fourth year high school and higher education	46	28	.....	8	.....	20	.....	.....	.....	.....	.....
Not reported	31	4	.....	3	.....	1	.....	.....	.....	.....	.....

Grade completed.	Minors in metal-manufacturing industries—[1]							
	Who last attended school outside Michigan.						Place of attendance not reported.	
	City.		Rural.		Not reported whether city or rural.			
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Total	322	35.3	13	1.4	26	2.8	24	2.6
Sixth and lower grades	58	44.3	3	2.3	11	8.4	2	1.5
Seventh grade	45	31.3	5	3.5	4	2.8	.....	.....
Eighth grade	114	34.0	4	1.2	8	2.4	2	.6
First year high school	32	29.9	1	.9	1	.9	1	.9
Second and third year high school	48	40.3	.....	.....	.....	.....	1	.8
Fourth year high school and higher education	18	.....	.....	.....	.....	.....	.....	.....
Not reported	7	.....	.....	.....	2	.....	18	.....

[1] Questionnaire group.

GENERAL TABLE X.—*Increase in weekly earnings from first to present position, by length of work history, and by sex; minors in metal-manufacturing industries.*[1]

Increase in weekly earnings from first to present position, and sex.	Minors in metal-manufacturing industries.[1]															
	Total.		Length of work history.													
			Less than 1 year.		1 year, less than 2.		2 years, less than 3.		3 years, less than 4.		4 years, less than 5.		5 years, less than 6.[2]	6 years, less than 7.[2]	7 years and over.[2]	Not reported.
	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.				
Total	913	100.0	122	100.0	159	100.0	217	100.0	193	100.0	123	100.0	65	15	11	8
No previous position	106	11.6	72	59.0	22	13.8	8	3.7	3	1.6			1			
Increase	398	43.6	25	20.5	61	38.4	106	48.8	97	50.3	65	52.8	33	9	2	
Less than $5	32	3.5	5	4.1	9	5.7	10	4.6	5	2.6	2	1.6		1		
$5, less than $10	80	8.8	12	9.8	15	9.4	26	12.0	15	7.8	8	6.5	4			
$10, less than $15	86	9.4	4	3.3	18	11.3	25	11.5	23	11.9	9	7.3	7			
$15, less than $20	73	8.0	2	1.6	5	3.1	23	10.6	16	8.3	19	15.4	6	2		
$20, less than $25	58	6.4	1	.8	7	4.4	12	5.5	17	8.8	13	10.6	4	3	1	
$25, less than $30	42	4.6	1	.8	5	3.1	9	4.1	12	6.2	7	5.7	8			
$30 and over	27	3.0			2	1.3	1	.5	9	4.7	7	5.7	4	3	1	
Same earnings	12	1.3	3	2.5	3	1.9	4	1.8			2	1.6				
Decrease	23	2.5	3	2.5	8	5.0	7	3.2	5	2.6						
Not reported	374	41.0	19	15.6	65	40.9	92	42.4	88	45.6	56	45.5	31	6	9	8
Boys	818	100.0	108	100.0	141	100.0	188	100.0	180	100.0	109	100.0	61	14	9	8
No previous position	90	11.0	63	58.3	19	13.5	6	3.2	2	1.1						
Increase	357	43.6	22	20.4	53	37.6	93	49.5	91	50.6	57	52.3	31	8	2	
Less than $5	25	3.1	3	2.8	7	5.0	8	4.3	4	2.2	2	1.8		1		
$5, less than $10	65	7.9	11	10.2	10	7.1	19	10.1	13	7.2	8	7.3	4			
$10, less than $15	74	9.0	4	3.7	17	12.1	22	11.7	20	11.1	6	5.5	5			
$15, less than $20	68	8.3	2	1.9	5	3.5	22	11.7	16	8.9	16	14.7	6	1		
$20, less than $25	56	6.8	1	.9	7	5.0	12	6.4	17	9.4	11	10.1	4	3	1	
$25, less than $30	42	5.1	1	.9	5	3.5	9	4.8	12	6.7	7	6.4	8			
$30 and over	27	3.3			2	1.4	1	.5	9	5.0	7	6.4	4	3	1	
Same earnings	11	1.3	3	2.8	3	2.1	3	1.6			2	1.8				
Decrease	18	2.2	3	2.8	6	4.3	6	3.2	3	1.7						
Not reported	342	41.8	17	15.7	60	42.6	80	42.6	84	46.7	50	45.9	30	6	7	8

[1] Questionnaire group.

[2] Per cent distribution not shown where base is less than 100.

GENERAL TABLE X.—*Increase in weekly earnings from first to present position, by length of work history, and by sex; minors in metal-manufacturing industries*—Continued.

Increase in weekly earnings from first to present position, and sex.	Minors in metal-manufacturing industries.														
	Total.		Length of work history.												
			Less than 1 year.		1 year, less than 2.		2 years, less than 3.		3 years, less than 4.		4 years, less than 5.		5 years, less than 6.	6 years, less than 7.	7 years and over.	Not reported.
	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.				
Girls	95	100.0	14	100.0	18	100.0	29	100.0	13	100.0	14	100.0	4	1	2	
No previous position	16	16.8	9	64.2	3	16.7	2	6.9	1	7.7			1			
Increase	41	43.2	3	21.4	8	44.4	13	44.8	6	46.2	8	57.1	2	1		
Less than $5	7	7.4	2	14.3	2	11.1	2	6.9	1	7.7						
$5, less than $10	15	15.8	1	7.1	5	27.8	7	24.1	2	15.4						
$10, less than $15	12	12.6			1	5.6	3	10.3	3	23.1	3	21.4	2			
$15, less than $20	5	5.3					1	3.4			3	21.4		1		
$20, less than $25	2	2.1									2	14.3				
Same earnings	1	1.1					1	3.4								
Decrease	5	5.3			2	11.1	1	3.4	2	15.4						
Not reported	32	33.7	2	14.3	5	27.8	12	41.4	4	30.8	6	42.9	1		2	

GENERAL TABLE XI.—*Grade completed, by sex, color, and nativity of child and nativity of father; minors in metal-manufacturing industries.*[1]

Grade completed and sex.	Minors in metal-manufacturing industries.[1]															
	Total.		White.										Negro.[3]	Color not reported.[2]		
			Total.		Native.							Foreign born.				
					Total.		Native father.		Foreign-born father.		Nativity of father not reported.[3]					
	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.		Number.	Per cent distribution.		Number.	Per cent distribution.
Total	913	100.0	568	100.0	448	100.0	270	100.0	172	100.0	6	120	100.0	21	324	100
Third and lower grades	8	.9	6	1.1	2	.4	2	.7	.....	.....	.....	4	3.3	1	1	.3
Fourth grade	16	1.8	10	1.8	6	1.3	2	.7	3	1.7	1	4	3.3	2	4	1.2
Fifth grade	35	3.8	18	3.2	8	1.8	7	2.6	1	.6	.....	10	8.3	1	16	4.9
Sixth grade	72	7.9	38	6.7	22	4.9	9	3.3	13	7.6	.....	16	13.3	10	24	7.4
Seventh grade	144	15.8	87	15.3	70	15.6	38	14.1	29	16.9	3	17	14.2	3	54	16.7
Eighth grade	335	36.7	215	37.9	182	40.6	109	40.4	73	42.4	.....	33	27.5	.....	120	37.0
First year high school	107	11.7	70	12.3	59	13.2	31	11.5	27	15.7	1	11	9.2	1	36	11.1
Second and third year high school	119	13.0	70	12.3	61	13.6	43	15.9	18	10.5	.....	9	7.5	1	48	14.8
Fourth year high school and higher education	46	5.0	30	5.3	26	5.8	21	7.8	5	2.9	.....	4	3.3	.....	16	4.9
Grade not reported	25	2.7	18	3.2	8	1.8	5	1.9	2	1.2	1	10	8.3	2	5	1.5
Still in school, grade not reported	6	.7	6	1.1	4	.9	3	1.1	1	.6	.....	2	1.7	.....	.....	.....
Boys	818	100.0	489	100.0	388	100.0	245	100.0	138	100.0	5	101	100.0	21	308	100.0
Third and lower grades	7	.9	5	1.0	2	.5	2	.8	.....	.....	.....	3	3.0	1	1	.3
Fourth grade	14	1.7	8	1.6	4	1.0	2	.8	1	.7	1	4	4.0	2	4	1.3
Fifth grade	33	4.0	16	3.3	8	2.1	7	2.9	1	.7	.....	8	7.9	1	16	5.2
Sixth grade	70	8.6	36	7.4	21	5.4	9	3.7	12	8.7	.....	15	14.9	10	24	7.8
Seventh grade	121	14.8	69	14.1	57	14.7	32	13.1	23	16.7	2	12	11.9	3	49	15.9
Eighth grade	299	36.6	186	38.0	158	40.7	97	39.6	61	44.2	.....	28	27.7	.....	113	36.7
First year high school	95	11.6	59	12.1	48	12.4	28	11.4	19	13.8	1	11	10.9	1	35	11.4
Second and third year high school	109	13.3	62	12.7	54	13.9	39	15.9	15	10.9	.....	8	7.9	1	46	14.9
Fourth year high school and higher education	46	5.6	30	6.1	26	6.7	21	8.6	5	3.6	.....	4	4.0	.....	16	5.2
Grade not reported	18	2.2	12	2.5	6	1.5	5	2.0	.....	.....	1	6	5.9	2	4	1.3
Still in school, grade not reported	6	.7	6	1.2	4	1.0	3	1.2	1	.7	.....	2	2.0	.....	.....	.....

[1] Questionnaire group.

[2] All native except 1 for whom nativity was not reported.

[3] Per cent distribution not shown where base is less than 100.

GENERAL TABLE XI.—*Grade completed, by sex, color, and nativity of child and nativity of father; minors in metal-manufacturing industries*—Continued.

Grade completed and sex.	Minors in metal-manufacturing industries.															
	Total.		White.										Negro.	Color not reported.		
			Total.		Native.							Foreign born.				
					Total.		Native father.		Foreign-born father.		Nativity of father not reported.					
	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.		Number.	Per cent distribution.		Number.	Per cent distribution.
Girls	95	100.0	79	.....	60	.....	25	.....	34	.....	1	19	.....	.....	16	.....
Third and lower grades	1	1.1	1	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....
Fourth grade	2	2.1	2	.....	2	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....
Fifth grade	2	2.1	2	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....
Sixth grade	2	2.1	2	.....	1	.....	.....	.....	1	.....	.....	1	.....	.....	.....	.....
Seventh grade	23	24.2	18	.....	13	.....	6	.....	6	.....	1	5	.....	.....	5	.....
Eighth grade	36	37.9	29	.....	24	.....	12	.....	12	.....	.....	5	.....	.....	7	.....
First year high school	12	12.6	11	.....	11	.....	3	.....	8	.....	.....	.....	.....	.....	1	.....
Second and third year high school	10	10.5	8	.....	7	.....	4	.....	3	.....	.....	1	.....	.....	2	.....
Grade not reported	7	7.4	6	.....	2	.....	.....	.....	2	.....	.....	4	.....	.....	1	.....

GENERAL TABLE XII.—*Type of trade training courses taken, by occupation; minors in metal-manufacturing industries.*[1]

Type of trade training courses taken.	Minors in metal-manufacturing industries.[1]												
	Total.		Apprentices.[2]	Assemblers.		Inspectors.		Laborers and helpers.		Machine operators.		Stock and tool room workers.[2]	All other.	
	Number.	Per cent distribution.		Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.	Number.	Per cent distribution.		Number.	Per cent distribution.
Courses taken in day school: Total reporting	[3] 873	100.0	41	101	100.0	125	100.0	116	100.0	191	100.0	99	200	100.0
Total taking courses	139	15.9	7	11	10.9	22	17.6	11	9.5	29	15.2	20	39	19.5
Metal trades	59	6.8	3	4	4.0	9	7.2	5	4.3	10	5.2	13	15	7.5
Woodworking	22	2.5	.....	1	1.0	2	1.6	4	3.4	5	2.6	1	9	4.5
Commercial	16	1.8	.....	.....	.....	5	4.0	.....	.....	5	2.6	2	4	2.0
Other	33	3.8	4	6	5.9	4	3.2	1	.9	8	4.2	4	6	3.0
Not reported	9	1.0	.....	.....	.....	2	1.6	1	.9	1	.5	.....	5	2.5
Taking no courses	734	84.1	34	90	89.1	103	82.4	105	90.5	162	84.8	79	161	80.5
Courses taken after leaving day school: Total reporting	[4] 807	100.0	34	97	100.0	112	100.0	105	100.0	174	100.0	89	196	100.0
Total taking courses	118	14.6	3	13	13.4	17	15.2	11	10.5	36	20.7	11	27	13.8
Metal trades	78	9.7	3	10	10.3	9	8.0	4	3.8	22	12.6	7	23	11.7
Woodworking	1	.1	.....	.....	.....	.....	.....	.....	.....	1	.6	.....	.....	.....
Commercial	13	1.6	.....	1	1.0	6	5.4	2	1.9	3	1.7	.....	1	.5
Other	20	2.5	.....	2	2.1	2	1.8	5	4.8	6	3.4	2	3	1.5
Not reported	6	.7	.....	.....	.....	.....	.....	.....	.....	4	2.3	2	.....	.....
Taking no courses	689	85.4	31	84	86.6	95	84.8	94	89.5	138	79.3	78	169	86.2

[1] Questionnaire group.
[2] Per cent distribution not shown where base is less than 100.
[3] Excludes 40 who did not report whether courses were taken.
[4] Excludes 106 who did not report whether courses were taken.

GENERAL TABLE. XIII.—*Type of trade training courses taken after leaving day school, by type taken in day school and by sex; minors in metal-manufacturing industries.*[1]

Type of trade training courses taken in day school, and sex.	Minors in metal-manufacturing industries.[1]																
	Total.	Total reporting.	Taking trade training courses after leaving day school.													Taking no courses.	Not reported whether any course taken.
			Total.	Metal trades.								Wood-working.	Commercial.	All other.	Type of course not reported.		
				Total.	Tool and pattern making.	Mechanical and electrical engineering.	Mechanical drawing and draftsmanship.	Machine-shop practice.	Foundry.	Automobile repair and assembly.	Other.						
Total	913	807	118	78	17	7	17	10	1	15	11	1	13	20	6	689	106
Total reporting	873	781	111	74	16	6	17	10	1	13	11	1	11	20	5	670	92
Total taking courses	139	118	36	25	7	2	8	4	.....	3	1	.....	5	4	2	84	19
Metal trades	59	52	19	14	5	.....	5	1	.....	2	1	.....	2	2	1	33	7
Tool and pattern making	17	15	7	5	4	.....	1	.....	.....	.....	.....	.....	.....	1	1	8	2
Mechanical and electrical engineering	2	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....
Mechanical drawing and draftsmanship	30	27	10	7	1	.....	4	1	.....	1	.....	.....	2	1	.....	17	3
Machine-shop practice	5	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	2
Foundry	2	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....
Automobile repair and assembly	2	2	1	1	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1	.....
Other metal trades	1	1	1	1	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....
Woodworking	22	20	8	4	.....	1	.....	2	.....	1	.....	.....	2	1	1	12	2
Commercial	16	12	2	1	1	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	10	4
All other	33	29	6	5	1	.....	3	1	.....	.....	.....	.....	1	.....	.....	23	4
Type of course not reported	9	7	1	1	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	2
Taking no courses	734	661	75	49	9	4	9	6	1	10	10	1	6	16	3	586	73
Not reported	40	26	7	4	1	1	.....	.....	.....	2	.....	.....	2	.....	1	19	14

Boys	818	728	113	78	17	7	17	10	1	15	11	1	10	18	6	615	90
Total reporting	786	709	107	74	16	6	17	10	1	13	11	1	9	18	5	602	77
Total taking courses	136	115	36	25	7	2	8	4	.....	3	1	.....	5	4	2	81	19
Metal trades	59	52	19	14	5	.....	5	1	.....	2	1	.....	2	2	1	33	7
Tool and pattern making	17	15	7	5	4	.....	1	.....	.....	.....	.....	.....	.....	1	1	8	2
Mechanical and electrical engineering	2	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....
Mechanical drawing and draftsmanship	30	27	10	7	1	.....	4	1	.....	1	.....	.....	2	1	2	17	3
Machine-shop practice	5	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	2
Foundry	2	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....
Automobile repair and assembly	2	2	1	1	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1	.....
Other metal trades	1	1	1	1	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....
Woodworking	22	20	8	4	.....	1	.....	2	.....	1	.....	.....	2	1	1	12	2
Commercial	14	10	2	1	1	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	8	4
All other	32	28	6	5	1	.....	3	1	.....	.....	.....	.....	1	.....	.....	22	4
Type of course not reported	9	7	1	1	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	2
Taking no courses	650	592	71	49	9	4	9	6	1	10	10	1	4	14	3	521	58
Not reported	32	19	6	4	1	1	.....	.....	.....	2	.....	.....	1	.....	1	13	13
Girls	95	79	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	2	.....	74	16
Total reporting	87	72	4	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	2	.....	68	15
Total taking courses	3	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	.....
Commercial	2	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....
All other	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....
Taking no courses	84	69	4	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	2	.....	65	15
Not reported	8	7	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	6	1

[1] Questionnaire group.

GENERAL TABLE XIV.—*Kind of school attended; minors in metal-manufacturing industries*[1] *who took trade training courses after leaving school.*

Kind of school.	Minors in metal-manufacturing industries who took trade training courses after leaving school.[1]		Kind of school.	Minors in metal-manufacturing industries who took trade training courses after leaving school.[1]	
	Number.	Per cent distribution.		Number.	Per cent distribution.
Total	118	100.0	Business schools	6	5.1
			Automobile schools	5	4.2
Public school	30	25.4	Other	17	14.4
Factory	21	17.8	Not reported	20	16.9
Correspondence	19	16.1			

[1] Questionnaire group.

GENERAL TABLE XV.—*Length of trade training course, by type of course; minors in metal-manufacturing industries*[1] *who took trade training courses after leaving school.*

Type of trade-training course after leaving school.	Minors in metal-manufacturing industries who took trade training courses after leaving school.[1]						
	Total.	Length of course.					
		Less than 3 months.	3 months, less than 6.	6 months, less than 9.	9 months, less than 12.	12 months and over.	Not reported.
Total	118	13	20	27	3	27	28
Metal trades	78	9	17	19	1	18	14
Tool and pattern making	17	1	3	3	.....	5	5
Mechanical and electrical engineering	7	.....	2	3	1	1	.....
Mechanical drawing and draftsmanship	17	3	3	6	.....	3	2
Machine-shop practice	10	1	3	1	.....	4	1
Foundry	1	.....	.....	1	.....	.....	.....
Automobile repair and assembly	15	3	3	2	.....	2	5
Other metal trades	11	1	3	3	.....	3	1
Woodworking	1	.....	.....	.....	.....	1	.....
Commercial	13	1	2	3	1	3	3
All other	20	3	.....	5	1	3	8
Not reported	6	.....	1	.....	.....	2	3

[1] Questionnaire group.

GENERAL TABLE XVI.—*Enrollment in specified class in night school, by occupation and industry and by sex; selected group of pupils in Detroit, Mich., night schools.*

Occupation and industry and sex.	Total pupils.[1]	Pupils in selected group in Detroit night schools enrolled in each specified class.						
		Mathematics.	Machine shop.	Automobiles.	Mechanical drawing.	Other drafting.[2]	Pattern making.	Welding.
Male	449	176	80	39	47	24	15	11
Manufacturing and mechanical	332	141	67	33	35	17	13	9
Iron and steel and other metal	265	110	63	30	30	13	12	8
Apprentices	18	9	2	1	8	.....	1	.....
Grinders and polishers	11	4	4	1	1	.....	.....	2
Grinders	10	4	3	1	1	.....	.....	2
Polishers	1	.....	1	.....	.....	.....	.....	.....
Machinists, millwrights, toolmakers	85	33	22	9	13	1	5	1
Machinists	38	13	11	3	5	.....	2	1
Tool and die makers	25	12	5	1	6	1	2	.....
Other[3]	22	8	6	5	2	.....	1	.....
Mechanics	10	.....	2	3	.....	.....	.....	4
Tinsmiths and coppersmiths	12	4	.....	.....	.....	6	.....	.....
Other occupations	129	60	33	16	8	6	6	1
Machine operators and machine hands	49	27	18	7	2	.....	.....	.....
Inspectors	20	5	5	1	3	1	2	.....
Assemblers	21	12	4	4	2	2	2	.....
Miscellaneous iron and steel	39	16	6	4	1	3	2	1
Building trades	11	2	.....	.....	2	4	.....	1
Electricians	37	24	3	2	2	.....	.....	.....
Other manufacturing	19	5	1	1	1	.....	1	.....
Transportation	22	2	.....	3	1	.....	.....	.....
Telephone	17	1	.....	.....	.....	.....	.....	.....
Other	5	1	.....	3	1	.....	.....	.....
Professional service	27	11	4	2	4	4	.....	1
Draftsmen and designers	17	7	3	2	3	3	.....	.....
Other	10	4	1	.....	1	1	.....	1
Clerical	50	18	4	1	4	3	2	1
Tool and stock	9	6	2	.....	.....	.....	.....	1
Other	41	12	2	1	4	3	2	.....
Other industries[4]	16	3	5	.....	3	.....	.....	.....
Not reported	2	1	.....	.....	.....	.....	.....	.....
Female	51	1	.....	.....	.....	1	.....	.....
Professional service	26	.....	.....	.....	.....	.....	.....	.....
Nurses	23	.....	.....	.....	.....	.....	.....	.....
Other	3	.....	.....	.....	.....	.....	.....	.....
Clerical	21	1	.....	.....	.....	1	.....	.....
Stenographers and typists	14	.....	.....	.....	.....	.....	.....	.....
Other	7	1	.....	.....	.....	1	.....	.....
Other industries	3	.....	.....	.....	.....	.....	.....	.....
Not employed	1	.....	.....	.....	.....	.....	.....	.....

[1] "Total pupils" is not total enrollment in the courses since some pupils were taking more than one course.

[2] Includes architectural drawing, sheet-metal drawing, body drafting, blue print, and designing.

[3] Includes 3 pattern makers.

[4] Includes trade, 7; domestic and personal service, 5; public service, 2; agriculture, forestry, and animal husbandry, 2.

GENERAL TABLE XVI.—*Enrollment in specified class in night school, by occupation and industry and by sex; selected group of pupils in Detroit, Mich., night schools*—Continued.

Occupation and industry and sex.	Pupils in selected group in Detroit night schools enrolled in each specified class—Continued.							
	Electrical.[5]	Radio.	Telephony.	Grades.	Pharmacy and chemistry.	Gymnasium and swimming.	English.	Other and not reported.
Male	33	9	15	14	24	4	21	7
Manufacturing and mechanical	23	6	.....	12	6	4	15	5
Iron and steel and other metal	7	4	.....	9	1	3	12	2
Grinders	.....	.....	.....	1	.....	.....	.....	.....
Machinists, millwrights, toolmakers	4	1	.....	2	.....	1	4	1
Machinists	2	1	.....	1	.....	1	4	.....
Tool and die makers	.....	.....	.....	.....	.....	.....	.....	1
Other[3]	2	.....	.....	1	.....	.....	.....	.....
Mechanics	.....	.....	.....	.....	.....	.....	1	.....
Tinsmiths and coppersmiths	.....	.....	.....	2	.....	.....	.....	.....
Other occupations	3	3	.....	4	1	2	7	1
Machine operators and machine hands	.....	1	.....	.....	1	1	3	.....
Inspectors	.....	.....	.....	.....	.....	.....	2	1
Assemblers	1	1	.....	.....	.....	1	.....	.....
Miscellaneous iron and steel	2	1	.....	4	.....	.....	2	.....
Building trades	.....	.....	.....	2	.....	.....	.....	1
Electricians	14	1	.....	.....	2	1	1	.....
Other manufacturing	2	1	.....	1	3	.....	2	2
Transportation: Telephone	1	.....	15	.....	1	.....	.....	.....
Professional service	3	.....	.....	.....	1	.....	1	.....
Draftsmen and designers	.....	.....	.....	.....	.....	.....	1	.....
Other	3	.....	.....	.....	1	.....	.....	.....
Clerical	6	2	.....	1	14	.....	1	1
Tool and stock	3	.....	.....	.....	1	.....	.....	.....
Other	3	2	.....	1	13	.....	1	1
Other industries[4]	.....	1	.....	1	2	.....	3	1
Not reported	.....	.....	.....	.....	.....	.....	1	.....
Female	.....	.....	.....	2	34	20	2	1
Professional service	.....	.....	.....	.....	29	2	.....	.....
Nurses	.....	.....	.....	.....	27	.....	.....	.....
Other	.....	.....	.....	.....	2	2	.....	.....
Clerical	.....	.....	.....	1	3	17	1	1
Stenographers and typists	.....	.....	.....	1	1	15	.....	.....
Other	.....	.....	.....	.....	2	2	1	1
Other industries	.....	.....	.....	1	.....	1	1	.....
Not employed	.....	.....	.....	.....	2	.....	.....	.....

[5] Includes electric laboratory, armature winding, electricity (direct current), electricity (alternating current), electrical construction.

APPENDIX IV.—A BRIEF BIBLIOGRAPHY.

GENERAL.

Federal Board for Vocational Education.

The Turnover of Labor. Bulletin No. 46. Employment Management Series No. 6. Government Printing Office, Washington, 1920. (60 pp.)

The meaning, cost, nature, and causes of labor turnover are discussed. Methods for computing and for reducing labor turnover are suggested.

Employment Management, Its Rise and Scope: The organization of an employment department, by Boyd Fisher and Edward B. Jones. Bulletin No. 50. Employment Management Series No. 1. Government Printing Office, Washington, 1920.

The Selection and Placement of Employees. Bulletin No. 49. Employment Management Series No. 2. Government Printing Office, Washington, 1919.

The Wage-Setting Process, by Alfred B. Rich. Bulletin No. 44. Employment Management Series No. 5. Government Printing Office, Washington, 1919.

New York Military Training Commission, Bureau of Vocational Training.

Our Boys: A study of 245,000 sixteen-, seventeen-, and eighteen-year-old employed boys of the State of New York, by Howard G. Burdge. J. B. Lyon Co., Printers, Albany, 1921. (345 pp.)

Simons, A. M.

Personnel Relations in Industry. The Ronald Press Co., New York, 1921. (341 pp.)

Mr. Simons emphasizes the need of job analysis on a national scale and discusses methods of hiring and training workers, labor turnover, factory conditions, democracy in industrial management, and other related topics.

U. S. Bureau of Education.

The Money Value of Education, by A. Caswell Ellis. Bulletin 1917, No. 22. Government Printing Office, Washington, 1917. (52 pp.)

In this bulletin Doctor Ellis discusses the value of education in developing national resources and its value to the individual. A list of references is included.

List of References on the Economic Value of Education. Prepared in the Library Division, U. S. Bureau of Education. Library Leaflet No. 4. Government Printing Office, Washington, 1919. (7 pp.)

U. S. Bureau of Labor Statistics.

Personnel Research Agencies: A guide to organized research in employment management, industrial relations, training, and working conditions, by J. David Thompson. Bulletin No. 299, Miscellaneous Series. Government Printing Office, Washington, 1921. (207 pp.)

Industrial Survey in Selected Industries in the United States, 1919. Preliminary report, prepared under the supervision of Allan H. Willett. Bulletin No. 265. Government Printing Office, Washington, 1920. (509 pp.)

This contains a table showing, by occupation, the number of employees, wages per hour, and hours of work for workers in various industries, among which are automobile, machinery, and machine-tool manufacturing.

U. S. Children's Bureau.

Standards of Child Welfare: A report of the Children's Bureau conferences, May and June, 1919. Bureau Publication No. 60, Separate No. 2, Child Labor. Government Printing Office, Washington, 1919.

Papers given at the Children's Bureau Conferences on Child Welfare, May and June, 1919, discussing the legislative prohibition of employment, the legislative regulation of employment, and vocational guidance and placement.

Minimum Standards for Child Welfare Adopted by the Washington and Regional Conferences on Child Welfare, 1919. Publication No. 62. Government Printing Office, Washington, 1920. (16 pp.)

In this bulletin are summarized the standards for children in industry as adopted by the conferences.

State Compulsory School-Attendance Standards Affecting the Employment of Minors, Legal Chart No. 2. Government Printing Office, Washington, 1921. (3 pp.)

School attendance laws affecting employment of minors are presented in chart form.

State Child-Labor Standards, Legal Chart No. 1. Government Printing Office, Washington, 1921.

Child labor laws of the various States are presented in chart form.

Industrial Instability of Child Workers: A study of employment-certificate records in Connecticut, by Robert Morse Woodbury, Ph. D. Publication No. 74. Government Printing Office, Washington, 1920. (86 pp.)

U. S. Public Health Service.

Comparison of an Eight-hour Plant and a Ten-hour Plant: Studies in industrial physiology: fatigue in relation to working capacity, by Josephine Goldmark and others. Bulletin No. 106. Government Printing Office, Washington, 1920.

An analysis of the effect of the longer hours upon maintenance of output, restricted output, industrial accidents, labor turnover, etc. Both plants under discussion are metal-working factories.

INDUSTRIAL EDUCATION AND VOCATIONAL GUIDANCE.

Bloomfield, Meyer.

Readings in Vocational Guidance. Edited by Meyer Bloomfield. Ginn & Co., Boston, 1915. (723 pp.)

This book contains a comprehensive selection of articles on vocational guidance prior to 1915.

Brewer, John M.

The Vocational-Guidance Movement, Its Problems and Possibilities. The MacMillan Co., New York, 1918. (333 pp.)

Contains a full bibliography.

Conference Board on Training of Apprentices.

Practical Apprenticeship: A bulletin of information on the training of industrial workers. Bulletin No. 2—Fundamentals of Apprenticeship. 1917. (30 pp.)

The board represents The National Association of Manufacturers, The National Founders' Association, The National Metal Trades Association, The United Typothetæ, Franklin Clubs of America, The National Tool Builders' Association, and The American Foundrymen's Association. Recommendations of the board in regard to supervision of apprentices, trade training, technical instruction, wages, bonuses, probation, examinations, duration of apprenticeship, physical, mental, and moral qualifications, and form of indenture.

Douglas, Paul H., Ph. D.

American Apprenticeship and Industrial Education: Studies in history, economics, and public law. Edited by the Faculty of Political Science of Columbia University. Vol. XCV, No. 2, Whole No. 216. Columbia University, Longmans, Green & Co., Agents, New York, 1921. (348 pp.)

The main divisions are as follows: American apprenticeship, its background, development, and decay; Juvenile labor and the educational requirements of modern industry; Modern substitutes for apprenticeship; and Social aspects. A bibliography is appended.

Federal Board for Vocational Education.

Bibliography on Vocational Guidance: A selected list of vocational-guidance references for teachers. Bulletin No. 66, Trade and Industrial Series No. 19. Government Printing Office, 1921. (35 pp.)

A good up-to-date bibliography compiled by Prof. Charles L. Jacobs, associate professor of education and supervisor of trade and industrial teacher-training classes, University of California, Berkeley, Calif.

Trade and Industrial Education, Organization, and Administration. Bulletin No. 17, Trade and Industrial Education Series No. 1. Government Printing Office, Washington, 1918. (125 pp.)

The bulletin was published to supply information and suggestion concerning the organization and administration of trade and industrial schools and classes under the Federal law.

Part-Time Trade and Industrial Education. Bulletin No. 19, Trade and Industrial Series No. 3. Government Printing Office, Washington, 1918.

A description of part-time school systems already established in the United States, Germany, England, and France; a discussion of types of part-time schools and a definition of Federal aid for part-time schools.

Buildings and Equipment for Schools and Classes in Trade and Industrial Subjects. Bulletin No. 20, Trade and Industrial Series No. 4. Government Printing Office, Washington, 1918.

Compulsory Part-Time School Attendance Laws. Bulletin No. 55, Trade and Industrial Series No. 14. Government Printing Office, Washington, 1921.

Trade and Industrial Education for Girls and Women. Part 1.—Economic and social aspects of vocational education for girls and women. Part 2.—Ways and means of establishing and operating a program. Bulletin No. 58, Trade and Industrial Series No. 15. Government Printing Office, Washington, 1920.

Part-Time Schools: A survey of experience in the United States and foreign countries, with recommendations. Bulletin No. 73, Trade and Industrial Series No. 22. Government Printing Office, Washington, 1922.

Emergency War Training for Oxy-Acetylene Welders. Bulletin No. 11. Government Printing Office, Washington, 1918. (86 pp.)

The first part treats of the development and application in industry and war of oxy-acetylene welding and cutting. The second part outlines the United States Army course in this type of welding.

Employment Management and Industrial Training. Bulletin No. 48, Employment Management, Series No. 4. Government Printing Office, Washington, 1920. (107 pp.)

Kelly, Roy Willmarth.

Training Industrial Workers. The Ronald Press Co., New York, 1920. (437 pp.)

Special emphasis is laid on the methods of organizing and conducting training within the factory. Public-school industrial training, vocational guidance, and kindred problems are discussed. A 22-page bibliography is appended.

Motley, James M., Ph. D.

Apprenticeship in American Trade Unions. Series XXV, Nos. 11–12, Johns Hopkins University Studies in Historical and Political Science. The Johns Hopkins Press, Baltimore, 1907. (122 pp.)

The history of apprenticeship under statute law, customary regulation, trade-union regulation, and trade agreement. The extent of union regulation by the American Federation of Labor, the purpose and character of regulation are discussed. The book gives a very exhaustive treatment of the subject.

Snedden, David.

Vocational Education. The MacMillan Company, New York, 1920. (587 pp.)

A discussion of current problems in vocational education.

U. S. Bureau of Education.

Vocational Secondary Education. Prepared by the Committee on Vocational Education of the National Education Association. Bulletin, 1916, No. 21. Government Printing Office, Washington, 1916. (163 pp.)

The bulletin contains a brief historic sketch, describes the kinds of schools established in this country, discusses terms and definitions used, methods for vocational education surveys, vocational guidance, and other problems. Primarily for those wishing to introduce vocational education into public schools.

The Apprenticeship System in its Relation to Industrial Education, by Carroll D. Wright. Bulletin, 1908, No. 6, Whole No. 389. Government Printing Office, Washington, 1908. (116 pp.)

A history of apprenticeship with a discussion of types of apprenticeship systems: (1) Type in which shop and school are intimately connected; (2) type under which apprentices are controlled to some extent outside working hours; (3) mixed types. Schools are listed and classified. A bibliography and a digest of laws are included.

List of references on Vocational Education. Prepared in the Library Division, Bureau of Education. Library Leaflet No. 15. Government Printing Office, Washington, 1922. (20 pp.).

U. S. Commissioner of Labor.

Twenty-fifth Annual Report of the Commissioner of Labor, 1910: Industrial education. Government Printing Office, Washington, 1911. (822 pp.)

An exhaustive report on industrial education in the United States, including philanthropic and public industrial schools, apprenticeship schools, cooperative industrial schools, evening industrial schools, textile schools, etc.

U. S. Training Service.

Industrial Training for Foundry Workers. Training Bulletin No. 24. Government Printing Office, Washington, 1919. (68 pp.)

The bulletin outlines in detail apprenticeship training in foundries, an upgrading system for foundry workers, and training for foremen, and gives outlines for the guidance of instructors, and a bibliography of technical books.

U. S. Training and Dilution Service.

A Successful Apprenticeship Tool Makers' School: Methods used by a large manufacturing company for training new employees to operate machine tools and for subassembly work, and to upgrade experienced operators for work in the tool rooms. Training Bulletin No. 2. Government Printing Office, Washington, 1918.

OCCUPATIONAL ANALYSES, INCLUDING VOCATIONAL-EDUCATION SURVEYS.

Boston (Mass.), Vocation Bureau.

Vocations for Boys.—The Machinist. Bulletin No. 1. The Vocation Bureau of Boston, Boston, 1911. (22 pp.)

Contains brief discussions of the divisions, dangers, conditions, and future of the trade; pay, positions, opportunities, qualities and training required, and apprenticeship.

Cleveland (Ohio) Education Survey.

The Metal Trades, by R. R. Lutz. The Survey Committee of the Cleveland Foundation, Cleveland, Ohio, 1916. (129 pp.)

Occupations, wages, opportunities, training, and general trade conditions are discussed for factories producing foundry and machine-shop products and automobiles, and for steelworks, rolling mills, and related industries.

Federal Board for Vocational Education.

Job Specifications. Bulletin No. 45, Employment Management Series No. 3. Government Printing Office, Washington, 1920.

A brief discussion of methods and uses of job analysis.

The Labor Audit: A method of industrial investigation. Bulletin No. 43, Employment Management Series No. 8. Government Printing Office, Washington, 1920.

This presents the reasons for making a labor audit, the prerequisites for a labor audit, the methods which may be used in making and in presenting a labor audit, and the results of a labor audit.

The Metal Trades: Molders, sheet-metal workers, machinists and machine operators, bench hands, assemblers, and erectors. For disabled soldiers, sailors, and marines, to aid them in choosing a vocation. Opportunity Monograph, Vocational Rehabilitation Series No. 7. Government Printing Office, Washington, 1919. (15 pp.)

A brief description of each occupation listed, its promotional opportunities, trade-training requirements, hours and wages, processes, and the kinds of workshops in which it is performed. Other occupations are treated in a similar way in other bulletins of the same series.

Oxy-Acetylene Welding. For disabled soldiers, sailors, and marines, to aid them in choosing a vocation. Opportunity Monograph, Vocational-Rehabilitation Series No. 9. Government Printing Office, Washington, 1919.

Occupations in the Automobile-Manufacturing Industry. For disabled soldiers, sailors, and marines, to aid them in choosing a vocation. Opportunity Monograph, Vocational-Rehabilitation Series No. 20. Government Printing Office, Washington, 1919.

The Indiana State Board of Education.

Report of the Indianapolis Survey for Vocational Education. Vols. I and II. Educational Bulletin No. 21, Survey Series No. 6, Indianapolis.

An analysis of occupations with special reference to skill and education required is given, together with a description of factory organization and factory processes and a discussion of the demand for labor, wages, school training needed, etc., by Charles H. Winslow, Special Agent for Vocational Research.

Report of the Richmond, Ind., Survey for Vocational Education. Robert J. Leonard, Director. Educational Bulletin, Vocational Series No. 15, Indiana Survey Series No. 3. Indianapolis, 1916. (599 pp.)

The common occupations in the industries of Richmond are described, hours, wages, and promotional opportunities specified, and the requirements for each analyzed, to discover what training, if any, is needed to fit the young worker to enter such occupations. Automobile, wire-fence, agricultural-implement, machine-tool, and other metal-manufacturing industries are included. A survey of the schools and an explanation of the survey method are included.

U. S. Bureau of Labor Statistics.

Vocational Education: Survey of Minneapolis, Minn., made by the National Society for the Promotion of Industrial Education. Bulletin Whole No. 199. Government Printing Office, Washington, 1917. (592 pp.)

Chapter VIII deals with the metal-working industries of Minneapolis, under the heads of description of occupations, general working conditions, hazards, demand for labor, and need for technical training of employees.

U. S. Army Trade Specifications and Index of Professions and Trades in the Army, Second Edition. War Department Document No. 774, Office of the Adjutant General. Government Printing Office, Washington, 1918. (239 pp.)

Duties and qualifications for each occupation needed in Army service are specified. Most kinds of metal-manufacturing work are included.

Vocational Education Survey of Richmond, Va. Bulletin Whole No. 162, Miscellaneous Series No. 7. Government Printing Office, Washington, 1916. (333 pp.)

The survey included several branches of the metal-manufacturing industry.

U. S. Department of Labor.

Descriptions of Occupations: Metal working, building and general construction, railroad transportation, shipbuilding. Prepared for the United States Employment Service by the United States Bureau of Labor Statistics. Government Printing Office, Washington, 1918. (123 pp.)

A description of each of the more important occupations is given, together with a statement of qualifications and schooling necessary. Arrangement is in outline form. Descriptions are somewhat technical.

INDUSTRIAL ACCIDENTS—PREVENTION AND ACCIDENT STATISTICS.

Beyer, David Stewart, Ph. D.

Industrial Accident Prevention, with Illustrations. Houghton, Mifflin Company, New York, 1916. (421 pp.)

The subject is treated under the following heads: General phases of the accident problem, building construction and arrangement, power generation and distribution, machine construction and arrangement, etc., special industries, fire hazard, explosion hazard, personal elements. The book is well illustrated. The treatment is somewhat technical.

Cowee, George Alvin, E. M., S. B.

Practical Safety Methods and Devices, Manufacturing and Engineering. D. Van Nostrand Company, 25 Park Place, New York, 1916. (434 pp. illus.)

The book is intended to provide for employers, superintendents, foremen, underwriters, safety inspectors, and engineers generally a convenient summary of standard safety methods and devices. It is therefore somewhat technical.

Detroit Public Library.

Accident Prevention in Industry: A selected bibliography compiled by the Detroit Public Library for the Accident Prevention Department of the Michigan Mutual Liability Co. Detroit, 1919. (7 pp.)

Federal Board for Vocational Education.

Industrial Accidents and Their Prevention. Bulletin No. 47, Employment Management Series No. 7. Government Printing Office, Washington, 1920. (66 pp.)

The bulletin discusses methods of safety organization and accident prevention, safety equipment, and accounting for safety.

Hansen, Carl M., M. E.

Universal Safety Standards: A reference book of rules, drawings, tables, formulæ, data and suggestions for use of architects, engineers, superintendents, foremen, inspectors, mechanics, and students, compiled under the direction of and approved by the Workmen's Compensation Service Bureau, New York. Second Edition, Revised and Enlarged. Universal Safety Standards Publishing Company, New York, 1914. (312 pp.)

As the title implies, the work is technical.

International Association of Industrial Accident Boards and Commissions.

Proceedings, 1916–1920, incl., U. S. Bureau of Labor Statistics Bulletins Nos. 210, 248, 264, 273, and 281, respectively. Government Printing Office, Washington.

Papers read at the annual meetings of this association deal with the administration of workmen's compensation laws, accident prevention, safety organization, accident statistics, and other related subjects.

Standardization of Industrial Accident Statistics: Reports of the committee on statistics and compensation insurance cost of the International Association of Industrial Accident Boards and Commissions, 1915–1919. U. S. Bureau of Labor Statistics Bulletin No. 276. Government Printing Office, Washington, 1920. (103 pp.)

This bulletin suggests standards, definitions, and methods of reporting accidents, a classification of industries, causes of accidents, location and nature of injury and extent of disability, and standard table forms to be used in reporting accident and compensation statistics.

Report of Committee on Statistics and Compensation Insurance Cost of the International Association of Industrial Accident Boards and Commissions. U. S. Bureau of Labor Statistics Bulletin, Whole No. 201, Industrial Accident and Hygiene Series No. 9. Government Printing Office, Washington, 1916. (128 pp.)

For the use of persons or organizations handling accident statistics. The committee recommends in detail a classification of industries, accident causes, and location and nature of injury and extent of disability. This bulletin has been superseded by No. 276, given above.

U. S. Bureau of Labor Statistics.

Causes of Death by Occupation, Occupational Mortality: Experience of the Metropolitan Life Insurance Company, Industrial Department, 1911–1913, by Louis I. Dublin, Ph. D. Bulletin, Whole No. 207, Industrial Accidents and Hygiene Series No. 11. Government Printing Office, Washington, 1917. (88 pp.)

Books and Periodicals on Accident and Disease Prevention in Industry in the Library of The Bureau of Labor Statistics. Government Printing Office, Washington, 1916. (23 pp.)

Industrial Accident Statistics, by Frederick L. Hoffman. Bulletin, Whole No. 157, Industrial Accidents and Hygiene Series, No. 5. Government Printing Office, Washington, 1915. (210 pp.)

A statement of the general accident problem in the United States is followed by a review of industrial-accident statistics in New York, Massachusetts, Illinois, and Wisconsin, and in some foreign countries. Standard methods of classification, tabulation, and analysis of industrial accidents are suggested.

Mortality from Respiratory Diseases in Dusty Trades (Inorganic Dusts), by Frederick L. Hoffman. Bulletin, Whole No. 231, Industrial Accidents and Hygiene Series, No. 17. Government Printing Office, Washington, 1918. (458 pp.)

Chapter II.—"Occupations with exposure to metallic dust" discusses dust hazards to which metal workers are exposed. Chapter III.—"Occupations with exposure to mineral dust" includes a discussion of dust, smoke, and gas hazards to which foundry workers are exposed. This work presents an exhaustive analysis of the information available on the subject.

The Safety Movement in the Iron and Steel Industry, 1907–1917, by Lucian W. Chaney and Hugh S. Hanna, June, 1918. Bulletin Whole No. 234, Industrial Accidents and Hygiene Series No. 18. Government Printing Office, Washington, 1918. (299 pp.)

The bulletin includes a discussion of the causes of accidents, accident-prevention work and safety organization accident rates, and accident experience in representative steel-manufacturing plants. Charts and illustrations add to the value of the text.

Causes and Prevention of Accidents in the Iron and Steel Industry, 1910–1919, by Lucian W. Chaney. U. S. Bureau of Labor Statistics Bulletin No. 298. Government Printing Office, Washington, 1922. (398 pp.)

This report brings together the results of a study of accidents in the iron and steel industry made by the Bureau of Labor Statistics during the last 10 years.

Accidents and Accident Prevention in Machine Building, by Lucian W. Chaney. Bulletin No. 256. Revision of Bulletin 216. Government Printing Office, Washington, 1920. (123 pp.)

The bulletin discusses different kinds of industrial accident rates, accident experience in different factories, safety organization in factories, safeguarding machinery and machine design as a factor of safety. Illustrations add to the value of the report.

Workman's Compensation Legislation of the United States and Foreign Countries, 1917 and 1918, September, 1918. Bulletin No. 243, Workmen's Insurance and Compensation Series. Government Printing Office, Washington, 1918. (477 pp.)

The bulletin contains an analysis of the principal features of the laws in each State of the Union, a discussion of the constitutionality and construction of statutes, an analysis of the laws of foreign countries, and the text of the various State laws.

U. S. Bureau of Labor Statistics—Continued.

Workmen's Compensation Legislation of the United States and Canada, by Lindley D. Clark and Martin C. Frincke, jr. Bulletin No. 272, Workmen's Insurance and Compensation Series. Government Printing Office, Washington, 1921.

This bulletin contains analyses and complete texts of laws.

Accidents and Accident Prevention: Report on Conditions of Employment in the Iron and Steel Industry in the United States, Vol. IV. Sixty-second Congress, First Session, Senate Document No. 110. Government Printing Office, Washington, 1913.

TECHNICAL BOOKS ON METAL-MANUFACTURING PROCESSES.

Colvin, Fred H., A. S., M. E., and Stanley, Frank A.:

Machine Shop Primer. An introduction to machine tools and shop appliances, with illustrations, names, and definitions. McGraw-Hill Book Company, New York, 1910. (148 pp.)

A book for apprentices on machine-shop work which names and illustrates the common machine-shop tools and serves as a reference book on mechanical subjects.

American Machinists' Handbook and Dictionary of Shop Terms: A reference book of machine shop and drawing room data, methods, and definitions. Third edition. McGraw-Hill Book Company, New York, 1920. (758 pp.)

A good technical reference book with a glossary of technical terms.

Danforth, G. W., United States Navy.

An Elementary Outline of Mechanical Processes. Arranged for the instruction of midshipmen at the United States Naval Academy and for students in general. The United States Naval Institute, Annapolis, Md., 1917. (423 pp.)

A brief account of the materials used in engineering construction and of the essential features in the methods of producing them. Also describes shop processes and equipment for the shaping of metals into forms for engineering and general uses.