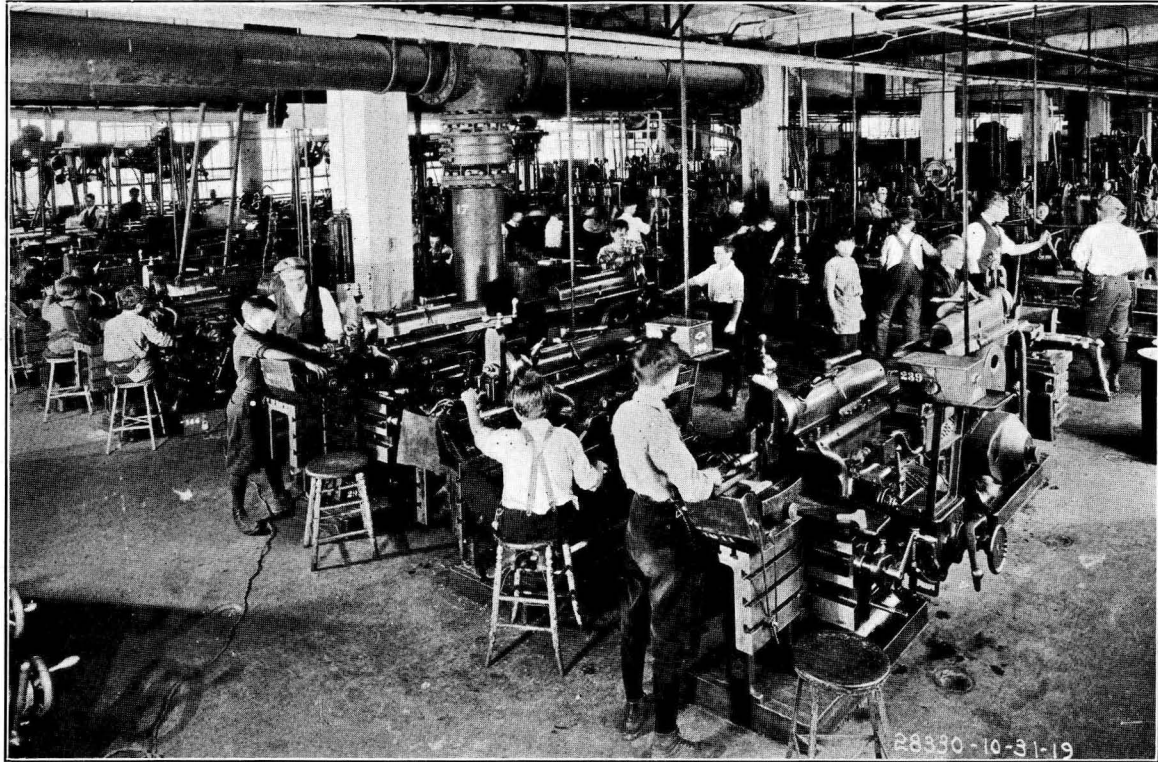


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PLATE I.—TRADE-SCHOOL SHOP. SHAPERS IN FOREGROUND.

U. S. DEPARTMENT OF LABOR

JAMES J. DAVIS, Secretary

CHILDREN'S BUREAU

GRACE ABBOTT, Chief

MINORS IN AUTOMOBILE AND
METAL-MANUFACTURING INDUSTRIES
IN MICHIGAN

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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.

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.

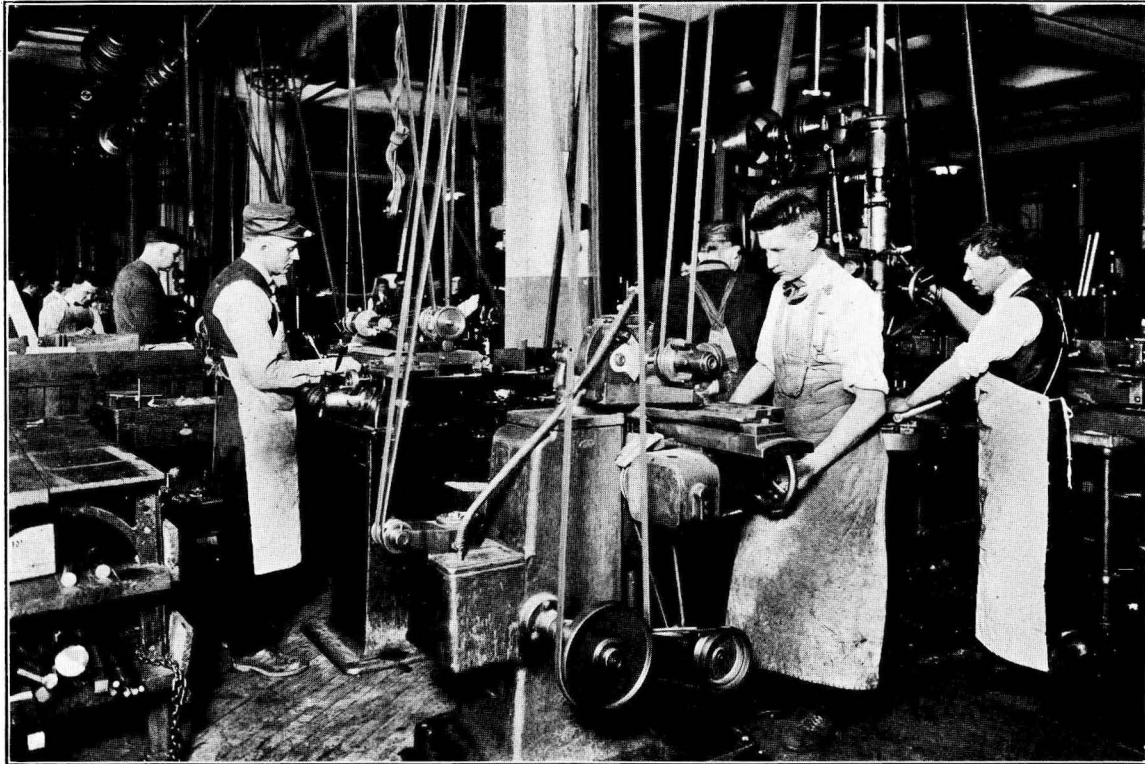
Scleroscope operator.

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.

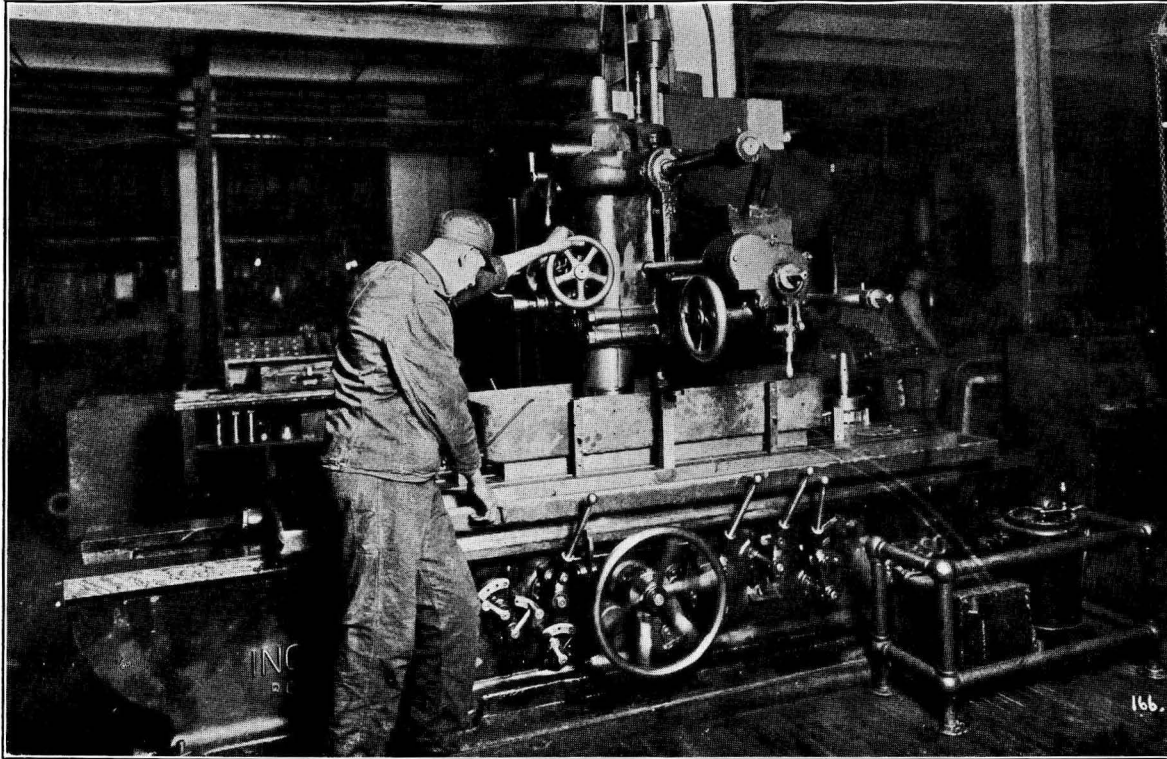
Requirements.—No technical education is necessary. Experience in the factory as assembler or machine operator is desirable.

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



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PLATE XI.—EXTERNAL GRINDING.



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

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.

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 gagers" 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 work-room 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.

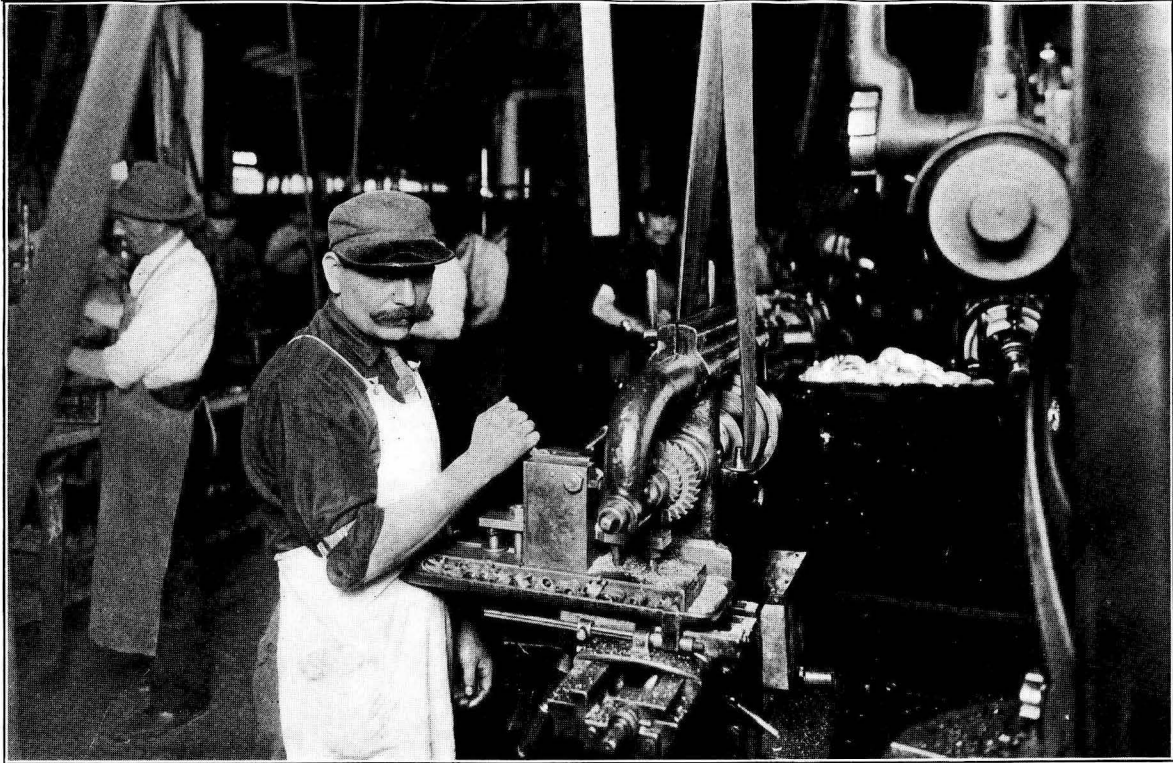
Blacksmith's helper.¹⁴

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.

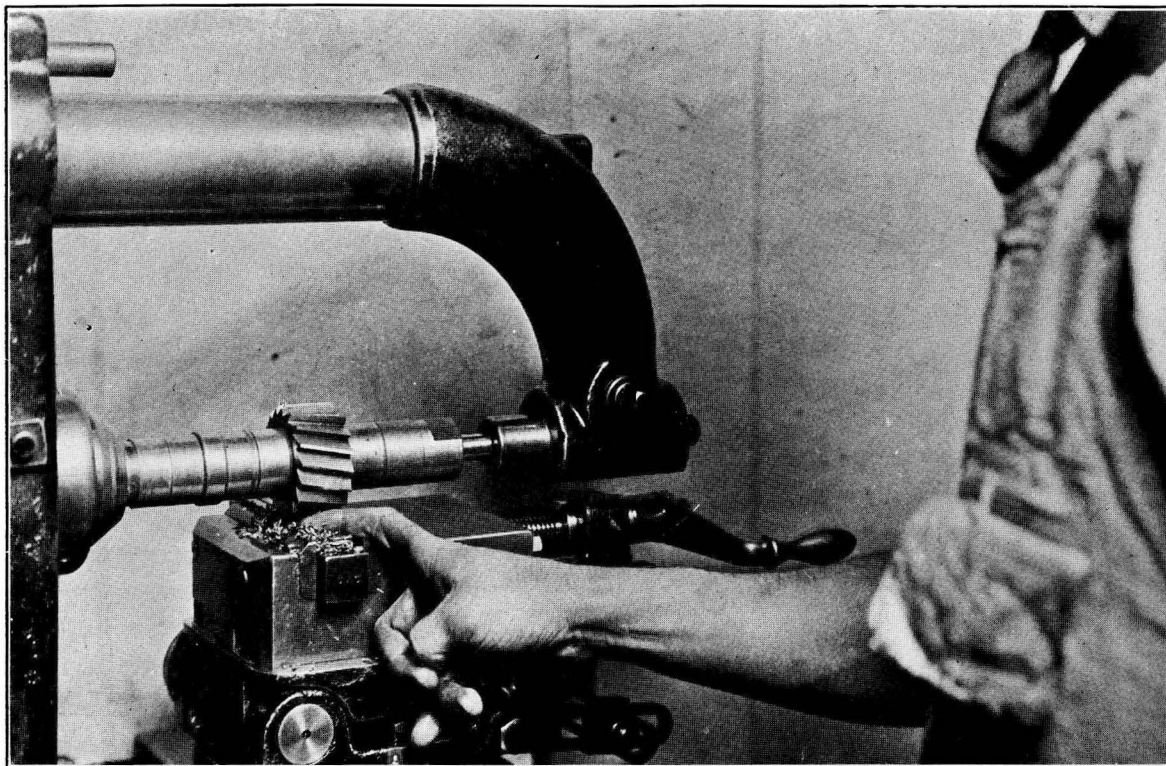
¹³ For earnings, see Table 7, p. 16, where occupation is classified under Heaters.

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.....	619	542	77	Machine operators—Contd.			
Drills.....	123	115	8	Boring.....	11	11	
Speed.....	4	4		Broach.....	6	6	
Other ¹	119	111	8	Planers.....	3	3	
Grinders.....	99	98	1	Presses.....	22	19	3
External.....	21	21		Punch-press.....	18	15	3
Internal.....	8	8		Stamp-press.....	3	3	
Surface.....	2	2		Other ¹	1	1	
Hand.....	1	1		Saws.....	13	13	
Tool.....	27	26	1	Screw.....	29	29	
Other ¹	40	40		Hand screw.....	9	9	
Milling.....	89	81	8	Automatic screw.....	5	5	
Hand.....	3	3		Other ¹	15	15	
Gear.....	15	13	2	Sewing.....	26		26
Other ¹	71	65	6	Gear shaper.....	1	1	
Lathes.....	98	94	4	Other shapers.....	4	4	
Turret.....	20	19	1	Shears.....	5	5	
Low swing.....	2	2		Tapping.....	8	6	2
Other ¹	76	73	3	Thread.....	26	11	15
				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.

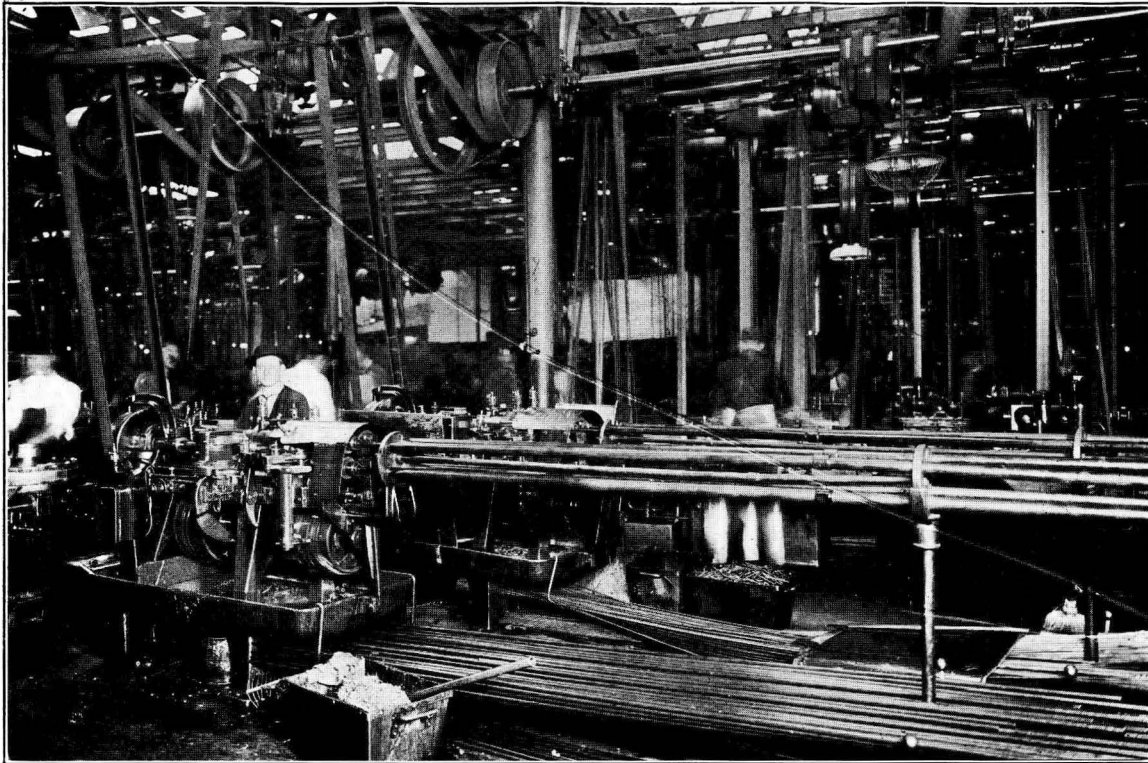
Learning period.—About two weeks in most factories. In one factory three years were required to become proficient, but in most of them proficiency could be gained in less than one year.

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

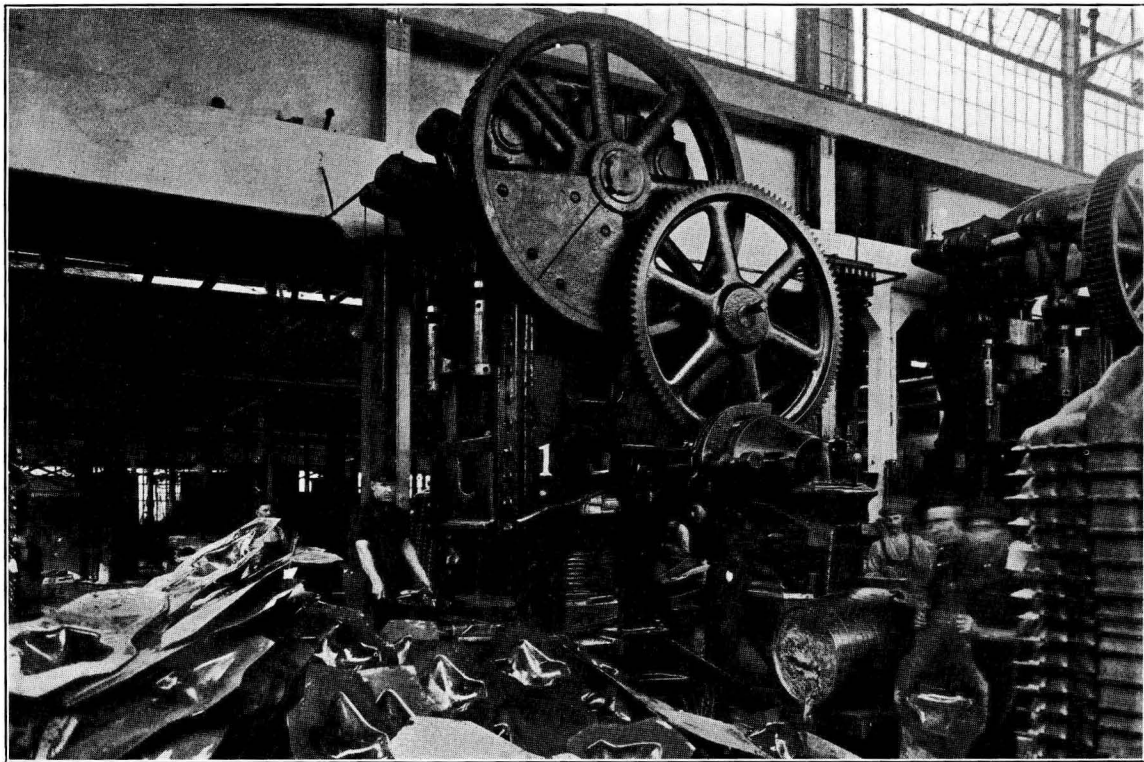
²⁵ For earnings, see Table 7, p. 16, where this occupation is classified under Machine operators—Milling.

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 repairmen³⁴ 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.

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 scratches.

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

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

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."

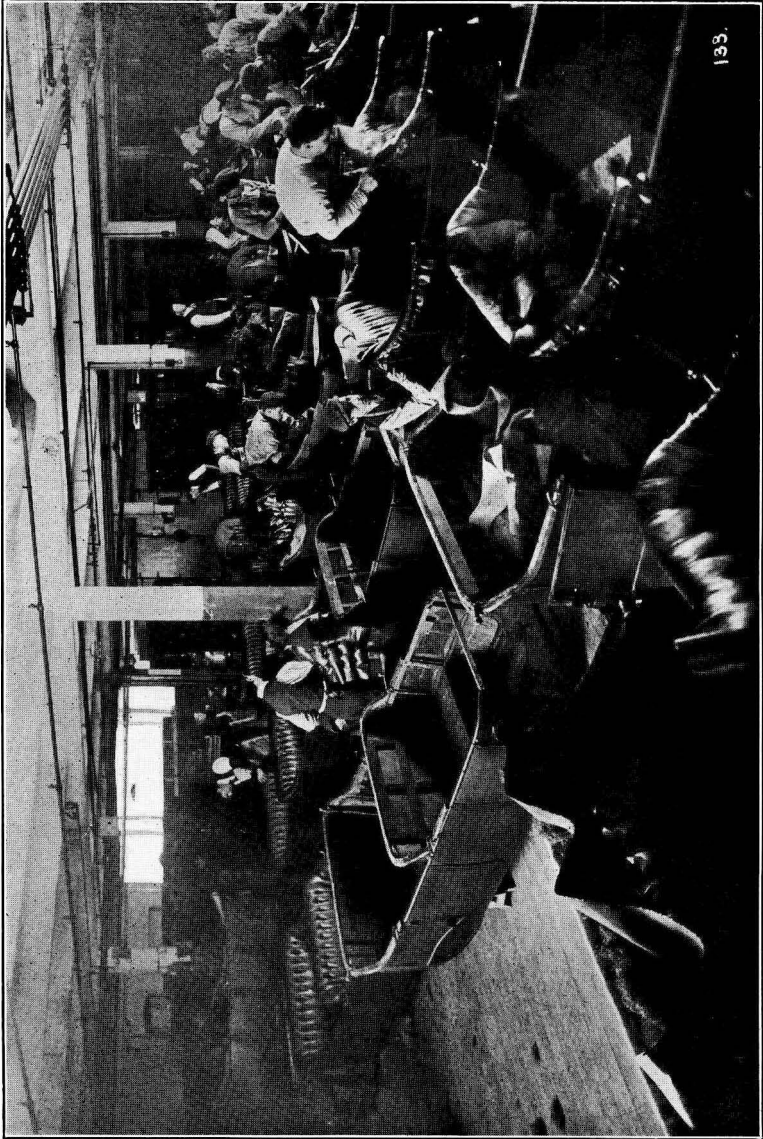
Hazards or strains.—Little hazard involved.

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 eye-strain.

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 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 1½ 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.

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, tanners, 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.

* 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.	
Num-ber.	Per cent.	Num-ber.	Per cent. ¹	Num-ber.			Per cent. ¹	Num-ber.			Per cent. ¹	Num-ber.			Per cent. ¹	Num-ber.			Per cent. ¹	
Total.....	26,192	23,412	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	8	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	2,866	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	1,037	967	70	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	89	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 ²	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.....	3,539	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	3,063	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.											Not reported. ¹	
			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.		
	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.....	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.....	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.

¹ 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.														Not reported. ¹
	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.		
	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			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	1.0	31	15.7	95	14.3	106	11.7	96	10.3	
48 hours, less than 51.....	380	13.4			3	1.9	38	19.2	82	12.4	113	12.5	127	13.6	1
51 hours, less than 54.....	127	4.5			6	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			5	7.0	6	3.0	32	4.8	37	4.1	30	3.2	
57 hours, less than 60.....	69	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.....	* 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	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	85	7.6	
45 hours, less than 48.....	301	11.9			1	1.0	27	15.8	81	14.4	95	11.7	87	10.1	
48 hours, less than 51.....	342	13.5			3	15	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.....	68	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.....	* 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.....	* 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.	
	Num-ber.	Per cent distribu-tion.	Num-ber.	Per cent distribu-tion.	Num-ber.	Per cent distribu-tion.	Num-ber.	Per cent distribu-tion.
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.....	85	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.	
	Num-ber.	Per cent distribu-tion.	Num-ber.	Per cent distribu-tion.	Num-ber.	Per cent distribu-tion.
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.

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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—									
	Reporting earnings per week.									
	Total.	Total reporting.	Less than \$5.		\$5, less than \$10.		\$10, less than \$15.		\$15, less than \$20.	
			Num-ber.	Per-cent.	Num-ber.	Per-cent.	Num-ber.	Per-cent.	Num-ber.	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.....	* 628	9							3	

Number of hours worked per week.	Minors in metal-manufacturing industries—									
	Reporting earnings per week.									
	\$20, less than \$25.		\$25, less than \$30.		\$30, less than \$35.		\$35 and over.		Not on pay l and not reported.	
	Num-ber.	Per-cent.	Num-ber.	Per-cent. ¹	Num-ber.	Per-cent. ¹	Num-ber.	Per-cent. ¹		
Total.....	334	15.2	423	19.3	339	15.5	496	22.6	* 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	2	1.4	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	67.3	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	60.9	8	17.4	20	43.5				
Not reported.....	31	4	12.9	3	9.7	1	3.2				

Grade completed.	Minors in metal-manufacturing industries— ¹							
	City.	Who last attended school outside Michigan.					Place of attendance not reported.	
		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	23	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.												Not reported.		
			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	
	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.	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	49.8	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	.....	.....	.....
\$20, less than \$25.....	58	6.4	1	.8	7	4.4	12	5.5	17	8.8	13	10.6	4	.....	.....	.....
\$25, less than \$30.....	42	4.6	1	.8	5	3.1	9	4.1	12	6.2	7	5.7	4	.....	.....	.....
\$30 and over.....	27	3.0	.....	.....	2	1.3	1	.5	9	4.7	7	5.7	.....	.....	.....	.....
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	13	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	.....	.....	.....
\$20, less than \$25.....	56	6.8	1	.9	7	5.0	12	6.4	17	9.4	11	10.1	4	.....	.....	.....
\$25, less than \$30.....	42	5.1	1	.9	5	3.5	9	4.8	12	6.7	7	6.4	4	.....	.....	.....
\$30 and over.....	27	3.3	.....	.....	2	1.4	1	.5	9	5.0	7	6.4	.....	.....	.....	.....
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.										Not reported.			
			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.
	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. ²	Color not reported. ³		
			Total.		Native.				Foreign born.							
	Number.	Per cent distribution.			Number.	Per cent distribution.	Total.		Native father.		Foreign-born father.		Nativity of father not reported. ³	Foreign born.		
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	.....	.....	10	5.3	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	64	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	4	1.6	1	.....	.....	4	4.0	2	4	1.3
Fifth grade.....	33	4.0	16	3.3	8	2.1	7	2.8	1	.....	.....	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	196	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.							
	Number.	Per cent distribution.			Number.	Per cent distribution.	Total.				Native father.		Foreign-born father.		Nativity of father not reported.	Number.	Per cent distribution.	Number.	Per cent distribution.
Girls.....			95	100.0			79	60	25	34		
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	.....	.....	.....	.....
Seventh grade.....	23	24.2	18	.....	13	.....	6	.....	6	.....	.....	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	.....	.....	.....	.....	.....	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. ³	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.....	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	1.0	2	1.6	4	3.4	5	2.6	1	9	4.5
Commercial.....	16	1.8	1	1	1.0	5	4.0	1	0.8	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	1	1	1.0	2	1.6	1	.9	1	.5	1	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.....	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	1	1.0	1	.8	1	.8	1	.6	1	1	.5
Commercial.....	13	1.6	1	1	1.0	6	5.4	2	1.9	3	1.7	1	1	.5
Other.....	20	2.5	2	2	2.1	2	1.8	5	4.8	6	3.4	2	3	1.5
Not reported.....	6	.7	1	1	1.0	1	.8	1	.8	4	2.3	2	2	1.0
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															Taking no courses.	Not reported whether any course taken.
	Taking trade training courses after leaving day school.																
	Total.	Total re- porting.	Total.	Metal trades.								Wood- work- ing.	Com- mer- cial.	All other.	Type of course not re- ported.		
				Total.	Tool and pattern mak- ing.	Me- chan- ical and electri- cal en- gineer- ing.	Me- chan- ical draw- ing and drafts- man- ship.	Ma- chine- shop prac- tice.	Found- ry.	Auto- mobile repair and assem- bly.	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	1	3	1	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 mak- ing.....	17	15	7	5	4	.....	1	.....	.....	.....	.....	.....	.....	1	1	8	2
Mechanical and elec- trical 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	.....	.....	.....	.....	.....	.....	2
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	118	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			1					1			22	4
Type of course not reported.....	9	7	1	1		1		3	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	1	13	13
Girls.....	95	79	5										3	2		74	16
Total reporting.....	87	72	4										2	2		68	16
Total taking courses.....	3	3														3	
Commercial.....	2	2														2	
All other.....	1	1														1	
Taking no courses.....	84	69	4										2	2		65	16
Not reported.....	8	7	1										1			6	1

¹ Questionnaire group.

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GENERAL TABLE XIV.—*Kind of school attended; minors in metal-manufacturing industries¹ 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
Public school.....	30	25.4	Automobile schools.....	5	4.2
Factory.....	21	17.8	Other.....	17	14.4
Correspondence.....	19	16.1	Not reported.....	20	16.9

¹ Questionnaire group.GENERAL TABLE XV.—*Length of trade training course, by type of course; minors in metal-manufacturing industries¹ 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.

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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.						
		Mathe-matics.	Ma-chine shop.	Auto-mo-biles.	Me-chani-cal drawing.	Other draft-ing. ²	Pattern mak-ing.	Weld-ing.
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				2
Polishers.....	1		1					
Machinists, millwrights, tool-makers.....	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 ⁴	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		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, tool-makers.....	4	1		2		1	4	1
Machinists.....	2	1		1		1	4	
Tool and die makers.....								1
Other ²	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 Thompeon. 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 Typothetae, 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, formulae, 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.



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