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DANGERS TO WORKERS FROM DUSTS AND FUMES AND METHODS OF PROTECTION

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DANGERS TO WORKERS FROM DUSTS AND FUMES AND METHODS OF PROTECTION.

BY WILLIAM C. HANSON, M. D.

INTRODUCTION.

The late Dr. Charles Harrington, under whose supervision was shown in Boston, Mass., in 1907, for the Massachusetts State Board of Health, the first exhibit in America relating to occupational diseases, called attention to the fact that the disastrous effects attributed to occupations were in very large part due to nonobservance of the principles of general hygiene and chiefly to inattention to that most important sanitary measure, perfect ventilation. He further gave it as his opinion that "with proper attention to this matter and improvement in the home and home influences, greater attention to the character and preparation of food, and a more general observance of the beneficial influence of active outdoor exercise, no very great differences would be noted in the health of the various classes of working people, and the expression 'occupational diseases' would lose whatever significance it now has."

The exhibit of the Massachusetts State Board of Health on the hygiene of occupations now contains more than 100 photographs. The photographs, charts, and materials which comprise the board's entire exhibit on the subject have four distinct aims: (1) To show conditions surrounding persons who work in the most sanitary establishments in some of the leading industries in Massachusetts; (2) to show conditions surrounding persons who work in establishments found to have moderately or distinctly bad sanitary conditions in all sorts of industries in the State; (3) to make clear the possibility of preventing diseases and pathological changes which now accompany certain occupations and manufacturing conditions; and (4) to demonstrate that factory hygiene is a part of community hygiene.

Of the collection of photographs, charts, and materials referred to, 62 photographs have been chosen for this article to illustrate the existence of occupational diseases in Massachusetts and to point out the places and conditions where dangers existed and the character of the device or devices which have proved successful in bettering conditions. For this purpose the photographs are displayed in groups as follows:

Group I. Occupations involving exposure to irritating and poisonous dusts.

Group II. Occupations involving exposure to irritating and poisonous fumes and vapors.

Group III. Occupations involving exposure to excessive humidity and intense heat.

The photographs shown under Group I illustrate occupations which involve exposure to vegetable, animal, mineral, and metallic dusts, and are divided into two sections. The first section illustrates occupations involving exposure to irritating dusts and the second section occupations involving exposure to poisonous dusts. The examples of exposure to irritating dusts are shown in the manufacture of cotton goods and of corn brooms, in the processes of chair making and other woodworking, in the manufacture of horn and celluloid articles, derby and felt hats, woolen goods, and boots and shoes, and in the working in metals and minerals. Examples of exposure to poisonous dusts are illustrated by processes in the lead industry.

The photographs shown under Group II, illustrating occupations which involve exposure to irritating or poisonous fumes and vapors, were taken from time to time as occasion arose. They include processes in the boot and shoe industry and the jewelry industry, in the manufacture of brushes, derby and felt hats, and storage batteries, and in casting yellow brass.

The photographs shown under Group III, illustrating occupations involving exposure to excessive humidity and intense heat, include workrooms in felt-hat factories and in laundries.

It should be stated that in every instance where employees appear in a photograph in connection with an industry or occupational process they are accurately represented at their work and are not posing. The object of the photographs, in other words, is not merely to indicate that dangerous work is done in the room in question, but to show employees as they are actually working together with the conditions under which they work.

For an adequate understanding of the possible unhygienic conditions to which the operatives may be exposed, a description of the various processes of manufacture is herewith presented.

GROUP I. OCCUPATIONS INVOLVING EXPOSURE TO IRRITATING AND POISONOUS DUSTS.

OCCUPATIONS INVOLVING EXPOSURE TO IRRITATING DUSTS.

VEGETABLE DUSTS.

Cotton industry.

Massachusetts stands first in the production of cotton goods and in textiles as a whole. A larger number of persons are employed in its factories than in any other industry and the majority of the employees are women and minors. Associated with the cotton industry are dangers which are direct and obvious in their effects upon the health of the workers, and for this reason the manufacture of cotton goods has been considered a dangerous trade. In justice to the industry, however, and to those manufacturers who are progressively attacking from a commercial point of view the very problems which go hand in hand with improved hygienic conditions, more emphasis may very properly be laid upon the avoidable dangers which, if removed, will go far toward taking the cotton industry from the list of dangerous trades.

The fact can not, of course, be overlooked that the work of the cotton-mill employees involves more or less constant confinement in a dusty atmosphere even in the best regulated fine-grade goods mill, but a careful consideration of other factors than cotton dust which affect injuriously the health of the workers shows that too little thought has been given to the evil consequences of poor light (especially in certain departments), excessive heat, nauseating odors, irritating gases, the products of gas combustion, the lack of proper means of ventilation, the failure to regulate properly the introduction of artificial moisture, and want of cleanliness.

The presence of dust in the air of cotton workrooms does not appear to be a prominent feature except in the first few processes which cotton undergoes after being taken from the bales. The intrinsic danger in the industry in this respect lies chiefly in the opening, picking, and carding processes, the danger varying with the construction of the mill, the amount of dirt and other impurities in the stock, the means of removing the dust, and some other factors.

By calling attention to the avoidable dangers of the cotton processes and by taking the necessary action relative thereto all or nearly all of the avoidable objectionable conditions may be eliminated. In this way the exact danger caused by the cotton dust in the several processes can then be more accurately judged.

Plate 1. Opening the cotton. The raw cotton is brought from the storehouse directly into the opening room or the picker room, according to the method of opening the bales. When the cotton is opened by hand, men take the bales to the cotton bins where they break up the cotton into small masses, mixing the various grades as required. As may be understood from the photograph, men take the cotton from bales or bins by armfuls, keeping the feed boxes filled.

Plate 2. Opening the cotton. In modern mills, the breaker machines are well equipped with hoods and pipes to carry off the dust.

Plate 3. Picker room. As cotton opens in the field, it catches and holds much fine dirt, blown about by the wind, and when it is subjected to the treatment of the beaters in the picker machines, the dirt and bits of seed and leaf are forcibly separated. In spite of the well-constructed modern picker machines, a considerable amount of fine dust escapes into the workroom—very slight, however, as compared with the amount which escapes from some of the older machines. Fires are frequent in the picker rooms, but are seldom dangerous to the men employed. The precautions against loss of property, now generally taken, also protect the employees from injury. The modern picker room is high studded; has several windows which admit sufficient light, and is equipped with incandescent bulbs or arc lights. The employees in the picker room are men. The photograph shows a room in a mill with moderately bad conditions, because of inadequate means of ventilation.

Plate 4. Picker room, showing well constructed, modern picker machines in a well-ventilated room.

Plate 5. Carding room. From the picker room the cotton is taken in the form of cylindrical laps to the carding room, where it passes through the carding machines. These machines clean the cotton further by removing a certain amount of short fiber and leaf, the amount being governed by the adjustment or setting of the card. The adjustment is governed by the class of work, which, in turn, bears a relationship to the amount of work, a smaller amount of work being put through the machines in the higher class, fine-grade goods. Thus it will be seen how, in the manufacture of print goods, with the use of short, lower-grade cotton, and with the large output per card, much more dust, dirt, and lint arise from the machines than during the manufacture of fine goods, with the long-staple, high-grade cotton. The photograph shows an old style carding machine in an old mill building, showing distinctly bad, unhygienic conditions. Because of the construction of these machines, they permit much fine lint or "fly" to escape into the room, an amount at times sufficient to cause a distinct haziness of the air. The employees in the card end of the room are men, while those in the other part are women.

Plate 6. Carding room. Cotton carding machinery has made great advances in recent years and the best mills have kept fully abreast with the latest improvements. The modern carding room is very large and high-studded with a good-sized window glass and transoms which are easily opened. It is well lighted and heated and ventilated by modern methods. The walls and ceilings are clean and white, and the floor is kept reasonably clean during working hours. The practical questions to be met in the card room are two, namely, (1)

Plate 6. Carding room—Concluded.
how to diminish substantially the amount of dust in the room, and (2) how to ventilate the room properly, both to be accomplished in old mills with reasonable expenditure. The photograph shows a model workroom with humidifying apparatus overhead and modern carding machines.

Plate 7. Card stripping. Old methods of card stripping are still in general use, notwithstanding the fact that a machine has been devised by which the process is made practically dustless. The process in general use gives rise to so much fine cotton dust as literally to cover the employees standing near by. The employees attending to this work are men. The photograph shows a circular brush over the stripping box. When in use, the brush is placed next to the cylinder between the two men who are standing at the machine.[1]

Plate 8. Card stripping. The introduction of the "Dustless cotton card stripping apparatus," invented and placed on the market in 1911, prevents an unusual and excessive amount of cotton fly and fine dust (not yet removed from the cotton) from flying in the air of the carding room. It appears to be a practical solution of the question of diminishing substantially the amount of dust in the room. The stripping device is fitted so perfectly to the card on one end and to a dust-tight patented machine on the other that practically no dust escapes into the air of the workroom. The use of the apparatus requires a little more time than the ordinary stripping roll consumes, but the extra time is more than offset by the better health of the employees and by the improved sanitary conditions in the workroom. This card stripping apparatus is now in use in a considerable number of cotton mills in Massachusetts and throughout New England and the Southern States.

Plate 9. Roving. This is an intermediate process between combing and spinning the untwisted cotton or "sliver." After going through the process of drawing and combing, it becomes so thin that it must be twisted in order to bear handling. Owing to the various kinds of work in the roving department, the employees consist of men, women, and minors. The photograph shows the process of roving as conducted in an old mill that is low-studded and insufficiently lighted and inadequately ventilated.

Plate 10. Roving. The process of roving as conducted in a modern and model workroom. Artificial humidity is used, well regulated. The work previous to roving is "standing work"; that of the roving processes permits of intervals for sitting. In some mills special seats are provided for the women employees.

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[1] In a paper entitled, "The Effect of Industry on Health," published in the Boston Medical and Surgical Journal Apr. 4, 1907, the writer referred to the process of card cleaning as an example of unavoidable conditions in the textile industry, as follows: "At times, for instance in the carding room of a cotton mill, cotton dust, although always present to some extent, flies about the room like snowflakes and covers the hair and clothes of the workers. The reason is that the metal-toothed cylinders of the carding machines become clogged from time to time with waste fibers and need to be cleaned; it is the cleaning that scatters the dust. Attempts have been made with more or less success to obviate this objectionable feature, but until the machine manufacturers shall devise some practicable means for getting rid of the dust, we must not blame the employers."

Plate 11. Ring spinning. The roving now goes to the spinning machine, which may be either a "ring frame" or a "mule." Except for the noise of the machinery (which is very great, but is uninterrupted and unvarying) and for the loose cotton dust in the air of the room, the spinners in a modern, well-regulated ring spinning room work under favorable conditions. Such a room is well ventilated, properly heated, has large windows and transoms which open, clean walls and ceilings, and is lighted by incandescent bulbs. The employees are mostly women, girls, and boys.

Plate 12. Mule spinning. In many mills the filling for the cloth is spun on frames called "mules." The operations of the mule-spinning frames are intermittent, the spindles being mounted in a traveling carriage which backs slowly away from the drawing rolls as the spinning proceeds, and then returns to wind a length of completed yarn; thus the specimen is repeated. The roving passes through the steel rollers, as in ring spinning, but is drawn out about 60 inches by the traveling carriage before it is wound on the spindles. Because of the long stretch covered by the traveling carriage, and since the filling has less twist than the warp, an extra amount of moisture in the air is necessary to prevent the ends from breaking. The air in mule-spinning rooms is very warm and moist at all seasons of the year. In the winter months the thermometer registers between 80° F. and 100° F., varying according to the class of work and the care and method of regulating the heat and moisture. The employees in "mule" rooms are all males; the spinners are men and the helpers are boys. The men spinners must walk to and fro, following the movements of the "carriage," which is constantly moving backward and forward, and looking after the piecing of broken ends and the adjustment of the mule. The photograph shows an old mill building with unsatisfactory mule-spinning conditions, including lack of cleanliness and a low-studded, ill-ventilated workroom.

Plate 13. Mule spinning. The good mule room, like the good ring-spinning room, is well lighted and ventilated. The photograph shows a model workroom in a modern mill. Owing to the high temperature in mule-spinning rooms, the men remove their outside clothing and wear undershirts and overalls, while the boys wear short trousers. Generally the men and boys go about the room barefooted, although many wear sandals, slippers, or old shoes.

Plate 14. Weaving. The weaver's duties are to put the cop into the shuttle, which is placed in the loom; to mend any broken warp threads; to observe all imperfections in the yarn, and to prevent imperfect yarn from being woven into the cloth. Each weaver keeps his looms oiled and cleaned and attends four, six, eight, or more looms, according to the kind of work and the kind of loom. More intelligence is required of an employee in a weave room than in any other department of a cotton mill, while that part of the work done by the "loom fixer" takes considerable physical strength. Weaving necessitates constant attention, although the weaver finds time to sit at intervals. Some kinds of work require great strength and endurance; some kinds are repugnant because of the conditions under which the work must be done, as in weaving dark-colored fabrics, or when dust arises from dyestuff or from shoddy; and some kinds demand an unusual degree of perfection in the product,

Plate 14. Weaving—Concluded.
calling for constant and minute attention. Thus it is clear that not only good light, evenly distributed, is a reasonable requirement in the weave room, but that good ventilation and proper regulation of heat and moisture are also hygienic essentials. The accompanying photograph, however, shows a weave room which fails to provide these necessary hygienic requirements, although the conditions may not be said to be distinctly bad. Both men and women work in the weave room; occasionally a few young persons.

Plate 15. Weaving. Modern workroom, with hygienic essentials. The conditions at present affecting the workers unfavorably, which, with our present limited knowledge, are unavoidable, are (1) the monotony of tending the machines day in and day out, and (2) the roar and buzz and the sharp jerky noise of the machinery, which is deafening and, to those particularly sensitive, "nerve-racking."

Broom-corn industry.

The broom-corn industry in this country started in Hadley, in the western part of Massachusetts. It is now confined mainly to New York and the Western States. Broom corn comes shipped in bales of stalks. In Hungary the seed is harvested free from the grain, but in the corn that comes from Oklahoma it is necessary, first, to thrash the seed of the straw. This process is not always done out of doors at the time the grain is gathered. In the factory it is a very dusty process and gives rise to the first criticism of the conditions of a broom factory.

Plate 16. Combing broom corn. While not a necessary process in the manufacture of brooms, the so-called scraping or thrashing machine should be used to scrape the seeds off the straw, and the machine should be connected with a fan and a box to catch the dust. Such a machine prevents much dust from escaping into the factory rooms in all of the various processes of manufacture. The corn thus thrashed still contains considerable dust which is a part of the growth itself; that is, the "down" or "fuzz" on the fiber. This dust of itself creates a haziness of the atmosphere. It is exceedingly irritating to the mucous membrane and causes a smarting and dry sensation to the eyes and the nose and upper air passages. To many persons it gives rise to respiratory diseases, such as asthma, hay fever, and bronchitis; to others it often causes an itching of the skin. The photograph shows employees combing out small bits of broom corn. The broom corn is held on a drum in which are nails that comb out the small pieces of corn. This process gives rise to considerable seed and dust from the fiber. Men, women, and minors do this work.

VEGETABLE AND MINERAL DUSTS.

Processes in chair making and other woodworking.

The woodworking machines employed are run at high speed, and in general are well guarded. These machines create much dust and large quantities of shavings and chips, but many of them are equipped

with exhaust fans and dust flues which lead to the furnaces. The dust which escapes into the air is not especially fine, and, while it settles to a considerable extent upon the operatives, it appears to cause no great discomfort.

Plate 17. Planing wood frames. The workman is entirely unprotected against rapidly flying fine hardwood and sand dusts while sandpapering wood frames.

Plate 18. Manufacture of chairs. A cylinder covered with a composition of sand and glue, like sandpaper, revolves rapidly against the wood, giving rise to fine, hardwood dust and fine sand. The photograph shows the absence of any dust-removal device for the protection of employees.

Plate 19. Manufacture of chairs. The exhaust suction pipe and hood designed to protect employees against dust in the process of chair making, while not entirely satisfactory, gives considerable protection.

ANIMAL AND VEGETABLE DUSTS.

Horn and celluloid industry.

In the year 1774, or shortly thereafter, the horn industry had its beginning in the United States in Massachusetts in the kitchen of the house of Obadiah Hills, of Leominster, in which town there are not fewer than 30 establishments, which give employment to more than 2,000 persons in the manufacture of combs and hairpins of horn and of celluloid.

Plate 20. Rounding and pointing hairpins with no dust-removal system. Owing to the absorbable nature of horn dust, the danger to employees is much less than that of the nonabsorbable dusts. The employees consist of men, women, and minors, according to the different kinds of work done.

Plate 21. Pointing teeth of celluloid combs. An effective dust-removal system for (a) the prevention of fire, and (b) the protection of health.

Manufacture of derby and felt hats.

In the manufacture of derby and felt hats the essential material is fur, and that used for the best product is from the cony and allied species. This comes to the factory clipped from the skin and treated with cyanide of mercury. The different kinds of fur are mixed together in large covered machines, in which the coarse hair is separated from the soft, downy fur, which latter is taken to the felt machine. This consists of a revolving copper cone, perforated with numerous small holes, through which the air is drawn by suction apparatus. The cone is inclosed in a barrel-like covering (open at the top), which has a door in the side for the removal of the felt as made. The fine hairs are blown into the upper part of the inclosure, are attracted toward the perforated cone by the air currents going thereto, and are deposited in a thin layer on the outside of the cone.

It is said that some men are affected by the mercury compound when they come in contact with it in handling the wet felt. The lesions produced are commonly a few bright red papules, occurring in groups of three or four, upon the backs of the fingers and hands; these papules itch intensely. Pustules also occur. Some men are so susceptible to the effects of mercury that they are obliged to discontinue their work.

Plate 22. Workmen attending felt machine. The men who attend these machines are subjected to more or less fine dust which gets into the atmosphere of the hat factory, as now constructed, in spite of precautions.

Woolen industry.

Three photographs are shown to represent model conditions in woolen mills. The processes chosen for this purpose are carding, spinning, and weaving.

Plate 23. Carding room. A modern workroom showing practically ideal sanitary conditions, e. g., good light, ample ventilation, and a high-posted workroom.

Plate 24. Spinning room. A modern workroom showing practically ideal sanitary conditions, e. g., excellent light and adequate means of ventilation.

Plate 25. Weaving room. A modern workroom showing practically ideal sanitary conditions as to light, ventilation, and the regulation of artificial humidity.

ANIMAL, MINERAL, AND VEGETABLE DUSTS.

Boot and shoe industry.

Second only to the textile industry, as a whole, but of greater commercial importance than either of the chief divisions of the same (cotton and woolen manufacture) alone, stands the boot and shoe industry. In this enormous industry many thousands of persons are employed in a large number of factories in many cities and towns in all parts of Massachusetts. The processes involved in the manufacture of boots and shoes are numerous and exacting, and some of them are accompanied by conditions which, unless care be taken to prevent their full influence, may cause injury to the health of the operatives. It is the "making department" of the boot and shoe factory that is of special sanitary importance from the point of view of protection of the employees against dust. The most dusty processes in this department are trimming, shaving, scouring, polishing, finishing, and cleaning parts of the shoe. The kinds of dust generated include leather, fine lint, fiber, bristles, dried blacking, wax, sand, emery, and carborundum.

Plate 26. Edge trimming. The process of trimming the edges of shoes gives rise to much coarse and considerable fine dust. The photograph shows a clogged and ineffective dust-removal system. The work requires good light, accurate eyesight, considerable skill, and close attention.

Plate 27. Edge trimming, showing an effective dust-removal system. The finest of the dust in well-equipped factories is sucked at once into the exhaust pipe.

Plate 28. Naumkeag buffing or naumkeaging. The naumkeag machine reaches that part of the shank which the rotary roll of the buffing machine can not touch, and it scours, brushes, and smooths the leather with carborundum for the staining process in the finishing department. It is really a part of bottom finishing. The dust-producing unit is oftentimes within 8 or 9 inches of the operative's face. If a man is of medium height, or below the average, or nearsighted, he is much exposed to fine carborundum and leather dust. On account of improperly constructed hoods there is undue exposure to dust from this type of machine. The photograph shows a machine with excellent hoods and a strong exhaust draft.

Plate 29. Xpedite finishing machine. The xpedite finishing machine polishes the outer surfaces of the heels after they have been blackened. This machine consists of an iron frame upon which are mounted two arbors. One arbor is 6 inches in front of and slightly below the other. The arbor in the rear supports at its left end a flat, slotted wheel, slightly less in width than an average heel. This heel wheel runs just near enough to a small wax pot, heated by a small gas flame, so that it is kept evenly coated with a thin layer of wax applied by a series of rubbing blows. The heel is then presented to a rapidly revolving small flat brush which travels to and fro across its surface, causing a smooth finish of unusual brilliancy. The forward arbor supports two 7-inch bristle brushes revolving at 750 to 850 times a minute, one of which is covered with a canvas jacket and has at its extreme left a small milled disk to mill the outer surface of the heel where it joins the shoe. The operative, standing before the xpedite finishing machine, presses the heel of the shoe against the wax wheel. In this way the heel is covered with a thin layer of wax. By next holding the shoe against the canvas-covered brush, the wax is evenly distributed over the heel and hardened. In some cases the wax wheel does not provide enough wax. The operative then holds a stick of wax against the canvas roll and repeats the process. The heel finishing is then completed by brushing on the bristle wheel. Some machines are provided with an additional rag wheel for final polishing. When improperly hooded the machine gives rise to considerable fine dust, consisting of a small amount of lint from the canvas roll, but mostly of fine particles of blacking, wax, and bristles from the brush. The photograph shows an xpedite finishing machine with one hood out of position, used by a workman for holding wax.

Plate 30. Xpedite finishing machine hooded, showing that the workman is using one-half of the area of the bottom hood for holding his wax and other materials.

Plate 31. Bottom finishing or polishing. No department of the shoe industry requires more attention and receives less, as regards dust-removal devices, than that of bottom finishing. It is the dirtiest part of the work, and the dust is of such a character as to be readily inhaled by the operative. The dust consists of fine lint, fiber, bristles, particles of blacking, stain, and wax. It is very light and easily distributed; drafts from windows, belts, shafting, etc., keep it in suspension in the air. It will thus be understood that if machines are improperly equipped with dust-removing devices the workmen will be covered with dust from head to foot. Until a careful study and report on the hygiene of the boot and shoe industry was made during the years 1910–1912 it was the exception rather than the rule to find the hoods connected with the blower system.[1] The photograph shows no dust-removal device to protect the workmen against dust.

Plate 32. Polishing shoes, with makeshift hoods that show a rather crude but not unreasonable arrangement for the protection of the employees against dust.

Plate 33. Polishing shoes, with a well-equipped hood and exhaust system, showing practically ideal protection.

METALLIC, MINERAL, AND VEGETABLE DUSTS.

Metal workers.

In the manufacture of machinery and metal supplies there are several operations which involve exposure to dust fumes, vapors, or extreme heat. In this section those operations only are considered which involve exposure to dust, namely, sand-blasting, cleaning and smoothing castings, and grinding and polishing.

Plate 34. Sand-blasting castings in open shed. Men who do the work are not properly protected, since the helmet does not prevent the inhalation of very fine steel, iron, or brass dust.

Plate 35. Sand-blasting castings in closed room, showing rubber-tube connection between the workman's helmet and a tank containing compressed air. Even this so-called "improved helmet" is an inadequate protection.

Plate 36. Tumbling castings. The photograph shows the process of tumbling castings as conducted in a closed room. Because of the absence of an exhaust system, the workmen are exposed to an excessive amount of dust.

Plate 37. Tumbling castings. The conditions here are in marked contrast to those obtaining in the workroom previously illustrated. The tumblers are of very tight construction, adequately ventilated by fans, and productive of no dust whatever.

[1] The State board of health of Massachusetts pointed out to a committee of the legislature of 1913 the need of authorizing the State board of labor and industries to determine the necessary devices or requirements for the prevention of occupational diseases in any or all establishments or employments and to make rules and regulations that may be applicable to an industry, process, or to a single factory or workshop; and such authority was given the State board of labor and industries and the industrial accident board, sitting jointly, by an act approved June 16, 1913.

Plate 38. Buffing brass. As seen by the photograph, there is in this department no dust-removal device to protect the employees against dust.

Plate 39. Buffing brass. The buffing wheels are well equipped with hoods and blowers and they give off practically no dust or lint.

Plate 40. Grinding steel castings on emery wheels. The emery wheels are provided with heavy iron hoods which cover them almost completely, so that the amount of steel and emery dust in the air is comparatively slight.

Plate 41. Brass or nickel polishing. The employee is polishing brass or nickel on cotton buff balls. Sometimes he puts an emery wheel on the machine and does emery polishing. Until found by a State inspector of health he was without protective devices for more than 15 years. Upon the recommendation of the State inspector of health he wore a sponge over his mouth for a respirator, and because of having been so unfortunate as to acquire tuberculosis he had a canvas with a mica window separating him from other employees. The jar was used as a receptacle for spitting. The hood and exhaust system were not altogether effective.

Plate 42. Grinding iron castings on heavy emery and carborundum wheels. Adjustable hoods are used for different-sized castings. The dust is removed by a downward suction, which is both less expensive than forcing against gravity and gives a better protection to the employees. The belting is boxed in, thus preventing the escape of considerable dust. A portion of the cover is removed for illustrative purposes.

Plate 43. Grinding iron castings on emery wheels. The effective dust-removal system protects the workmen to a great extent from flying dust.

Plate 44. Cleaning iron castings. The workman is exposed to an excessive amount of dust.

NONMETALLIC DUSTS.

Mineral workers.

Of the several classes of dusts, those of vegetable, animal, metallic, and mineral, it is difficult to determine which is the most irritating to the respiratory tract; but the vegetable dusts are commonly so regarded, in spite of the well-known fact that the occupations in which the employees inhale minute particles of stone, steel, and glass are remarkable for their high death rates from tuberculosis of the lungs. But not all of the dusts of one class are equally irritating. While stone cutting is preeminently a dusty trade and justly classed as one of the dangerous occupations, of the various kinds of stone dust granite is regarded more injurious than marble, and soapstone the least of all; but different granites vary in this particular, some yielding finer dusts than others on account of differences in texture. The greatest amount of dust comes from the surfacing machines which are operated with compressed air. Plate 45 illustrates this process.

In the manufacture of pearl buttons machines with cutters resembling surgical trephines cut disks out of shells, with evolution of much fine dust. In Massachusetts, under the law which authorized the State board of health to determine whether or not any particular trade, process of manufacture, or occupation, or any particular method of carrying on such trade, process of manufacture, or occupation, was sufficiently injurious to the health of minors under 18 years of age therein which justified their exclusion therefrom, viz, chapter 404, acts of 1910, the State board of health declared "cutting, boring, turning, planing, grinding, doming, facing, or polishing pearl shell" to be "processes involving exposure to irritating dusts" within the meaning of the said law. The result is that in Massachusetts to-day persons under 18 years of age are excluded from this work.

Plate 45. Stone cutting. The strong blast of air keeps the granite clean, but gives rise to a great amount of dust. The surfacing tool is either a large hammer or an instrument which presents four smaller separate faces. Sometimes a bushing hammer, made of thin, chisel-like blades bolted together, is used; this creates the finest dust of all. The men who operate the surfacing tools rarely wear masks. Some protect themselves from flying chips by means of wire screens placed about the hammer; some wear wire masks, and some wear glasses.

Plate 46. Pearl button making. Planing or grinding pearl disks. The girl in the foreground of the picture is 16 years of age. She places the disks on a belt which runs beneath the revolving wheel. The girl in the corner is drilling holes in pearl disks. Neither girl is protected against the pearl dust which flies about each. The exhaust system for removing the dust is ineffective.

Plate 47. Facing, grinding, polishing, and doming pearl shell. The women are exposed to considerable dust, even with what would seem to be an effective exhaust system.

OCCUPATIONS INVOLVING EXPOSURE TO POISONOUS DUSTS.

Lead industry.

White lead is not manufactured in Massachusetts. Minors who are under 18 years of age are excluded from any trade, process of manufacture, or occupation involving exposure to lead dusts or substances.

Plate 48. Lead working in the manufacture of storage batteries. Red oxide of lead and litharge are mixed together. One man doing this kind of work was found to be suffering from lead poisoning. The picture shows an employee wearing a respirator. The man was unwilling to wear long-wristed gloves.

Plate 49. Removing lead from the oven into metal pan. The workman is unprotected against lead dust.

Plate 50. Shoveling lead oxide into hopper. The workman wears a respirator.

GROUP II. OCCUPATIONS INVOLVING EXPOSURE TO IRRITATING AND POISONOUS FUMES AND VAPORS.

Naphtha intoxication is a rare occupational disease in Massachusetts. There are a number of different processes in various occupations, however, which cause employees to be exposed to naphtha fumes to such an extent as to give rise to occipital headache in the morning, sensations of faintness or dizziness, loss of appetite, and anemia, all of which symptoms generally disappear within a few weeks' time with hygienic treatment. In the shoe industry, for example, in some departments, according to the process of manufacture, the edges of the vamps, or fore parts of the shoes, are covered with a cement made of rubber and naphtha. This cement was formerly kept in small bowls on the benches in front of the girls employed at this work, who therefore were exposed to the fumes of the naphtha arising therefrom. Under the law above referred to relative to the exclusion of minors from injurious processes, the use of naphtha in cement work in rooms in shoe and rubber factories which are not provided with mechanical means of ventilation, while the mixture containing naphtha is allowed to remain in uncovered receptacles, is prohibited. Other processes which give rise to naphtha fumes from which minors are excluded are (1) spreading rubber on cloth in the manufacture of rubber goods and (2) processes involving exposure to naphtha in the manufacture of japanned or patent leather.

Plate 51. Room in boot and shoe factory. Women and girls are exposed to the fumes of naphtha from open bowls of cement in a stitching room of a boot and shoe factory.

Plate 52. Room in boot and shoe factory. Naphtha cement is kept in closed receptacles—the tops being open for short intervals only when the operatives are actively at work—or in specially constructed containers, so that the women and girl operatives are no longer exposed to any appreciable extent to naphtha fumes.

Plate 53. Casting yellow brass. The disease to which brass workers are commonly subject is known as "brass founders' ague," which, according to some authorities, is caused by the inhalation of oxide of zinc, while others attribute it to copper poisoning. In foundries where brass or composition is cast, employees are exposed to fumes from the zinc which enters into the composition of these metals. The metals are usually melted in fire pots which are covered with iron covers, so that during the melting little or no gas escapes. When the metal is ready for pouring, the crucibles are lifted out by means of long iron holders and are carried by two men to the molds, where it is poured. It is during this process that the gray fumes, which, on being cooled by the air of the room, precipitate into fine gray powdered flakes, fill the room and are unavoidably inhaled by the workers. The picture shows two workmen in the act of pouring the metal into the molds.

Plate 54. Casting yellow brass. Brass workers protected against zinc fumes.

Plate 55. Manufacture of derby and felt hats. The felt cone is treated with a solution of shellac and wood alcohol, and the excess is wrung out. Then it is placed in a drying oven, and the alcohol is dried out of the felt, condensed, and recovered. In some establishments visited, the fumes of wood alcohol in this department were markedly strong; and the workmen stated that they were frequently troubled with headaches, vertigo, smarting and burning of the eyes and impairment of vision, and that few could remain at this work longer than three or four months at a time. The photograph shows a workman treating felt cones. The removal of poisonous fumes is not entirely satisfactory.

Plate 56. Brush making. In the manufacture of brushes a cement of wood alcohol and shellac is used. The photograph shows employees exposed to fumes of wood alcohol which are not satisfactorily removed.

Plate 57. Manufacture of storage batteries. Photograph of a process in the manufacture of storage batteries shows workmen exposed to hydrogen gas, although a large fan in the workroom serves as an exhaust.

Plate 58. Jewelry industry. Workmen are exposed to dilute cyanide of potassium. After the piece of jewelry is polished with cotton cloth wheels and bristle brushes, it is ready for the "coloring solution," which consists of a weak solution of potassium cyanide and gold, kept very hot and commonly uncovered. This gives a slight coating of 24-carat gold which serves to bring out the depth of color for relief and to give a finished appearance, but has no wearing qualities. The photograph shows employees at work over a coloring bath which contains dilute cyanide of potassium.

GROUP III. OCCUPATIONS INVOLVING EXPOSURE TO EXCESSIVE HUMIDITY AND INTENSE HEAT.

Plate 59. Manufacture of felt hats. In the manufacture of felt hats, after the fine hairs are deposited to a sufficient extent in a thin layer on the outside of the copper cone, a cloth wrung out in hot water is applied and the cone and its covering are removed and plunged into hot water for a short time, the heat and moisture causing the individual hairs to become more intimately matted, then the conical layer is pulled off and sent to the shrinking room. The workmen are exposed to excessive heat and humidity.

Plate 60. Manufacture of felt hats. Reasonable protection against excessive heat and humidity.

Plate 61. Laundry workers. In addition to a possible danger from contact with the infectious material of soiled clothes, laundry workers are exposed to overheat and excessive humidity created by the processes of the industry. The processes carried on in laundries unavoidably create high temperature and often damp air. The photograph shows a flat-work ironing machine unprotected with hoods connected by suction pipes with exhaust fans, so that the steam as it is generated disperses through the room.

Plate 62. Laundry workers. In a few laundries the flat-work ironing machines were provided with excellent overhead hoods connected by suction pipes with exhaust fans.

While it is generally recognized that certain occupational processes are injurious to health and that insanitary conditions in workshops and factories are prejudicial to the welfare of operatives, very little has been done in this country to make systematic investigations into industrial conditions. In 1907 the Massachusetts State Board of Health issued its first report dealing with dangerous occupations. Massachusetts was thus the first State in the Union to recognize the fact that sanitary inspection of factories was essentially a health matter. Since then much valuable information on occupational hygiene has been gathered by the Massachusetts State inspectors of health, and our knowledge of occupational processes and conditions is increasing. A few exceedingly important investigations have been made in the subject elsewhere in the country, notably the reports of the Illinois commission and of the United States Bureau of Labor.[1]

[1] See Report of (Illinois) Commission on Occupational Diseases, January, 1911, and the following reports published in the bulletins of the United States Bureau of Labor Statistics: "Phosphorus poisoning in the match industry in the United States," by John B. Andrews, Bull. No. 86, January, 1910; "The white-lead industry in the United States, with an appendix on the lead-oxide industry," by Alice Hamilton, and "Deaths from industrial lead poisoning (actually reported) in New York State in 1909 and 1910," by John B. Andrews, Bull. No. 95, July, 1911; "Lead poisoning in potteries, tile works, and porcelain enameled sanitary ware factories," by Alice Hamilton, Bull. No. 104, Aug. 7, 1912; "Hygiene of the painters' trade," by Alice Hamilton, Bull. No. 120, May 13, 1913.

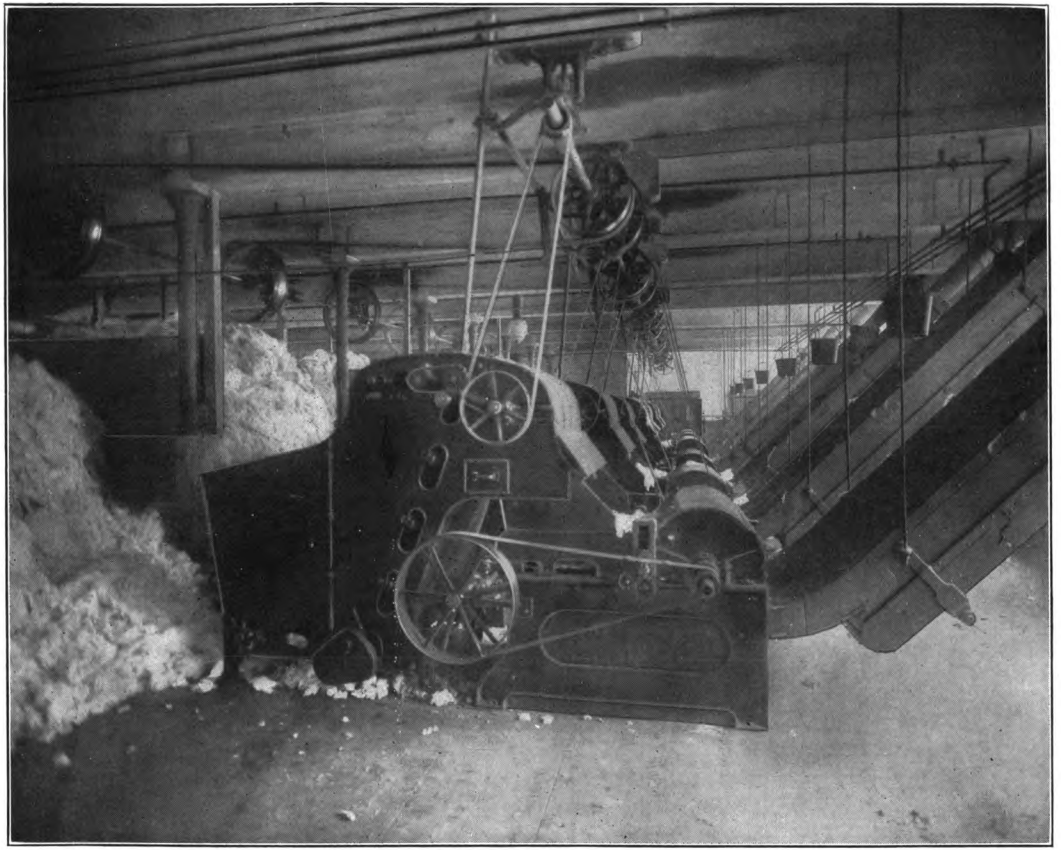

PLATE 1.—OPENING THE COTTON.

In feeding the breaker machines the men take the cotton from the bins by armfuls, and no provision is made in the room shown for carrying off the dust.

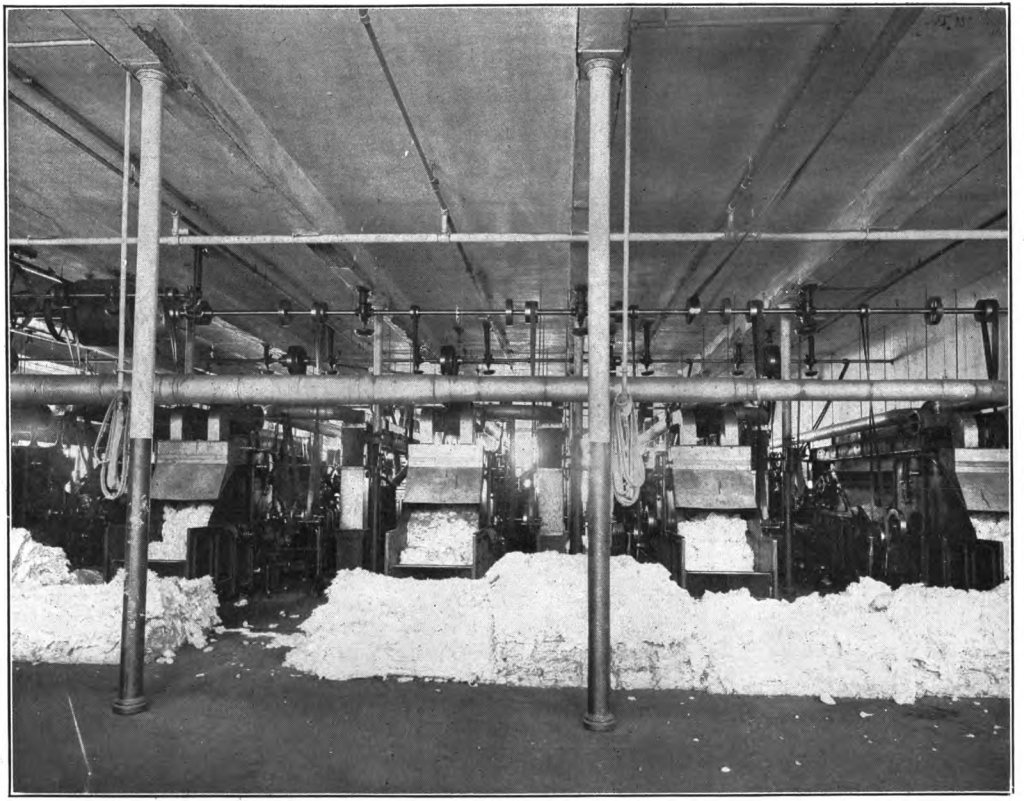

PLATE 2.—OPENING THE COTTON.

This room is in a modern mill in which the breaker machines are well equipped with hoods and pipes to carry off the dust.

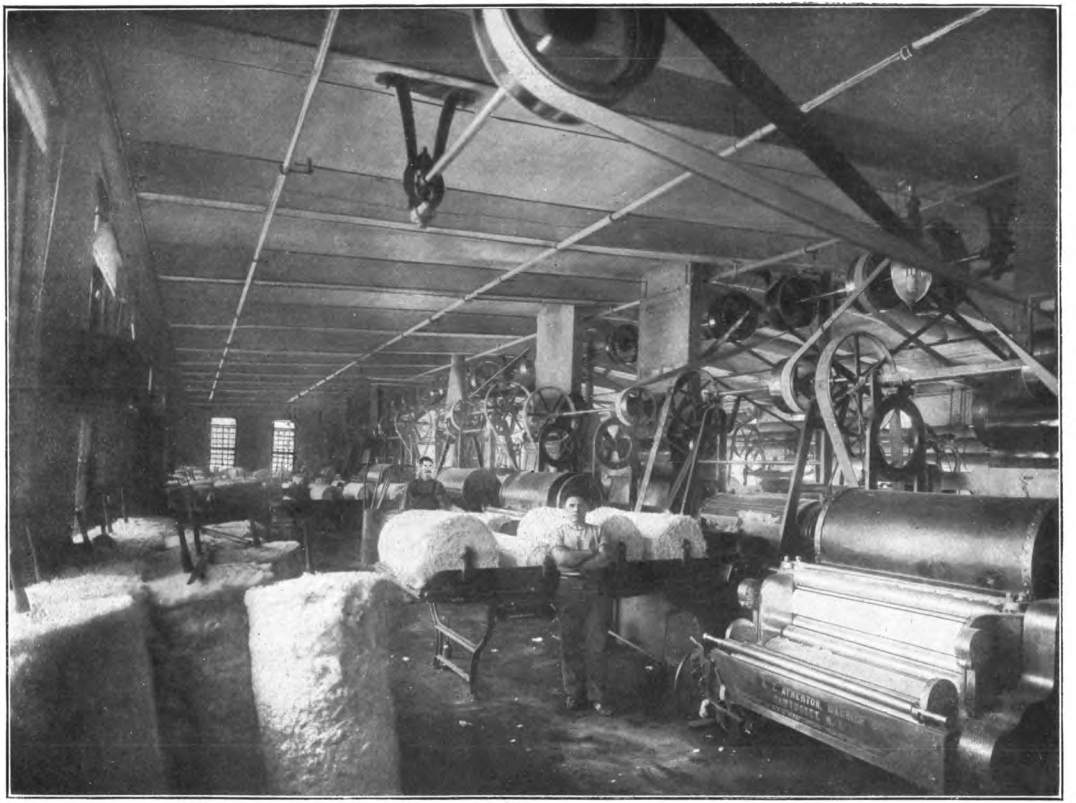

PLATE 3.—PICKER ROOM IN COTTON MILL.

In separating dirt from cotton much fine dust escapes. In the room shown the conditions are moderately bad.

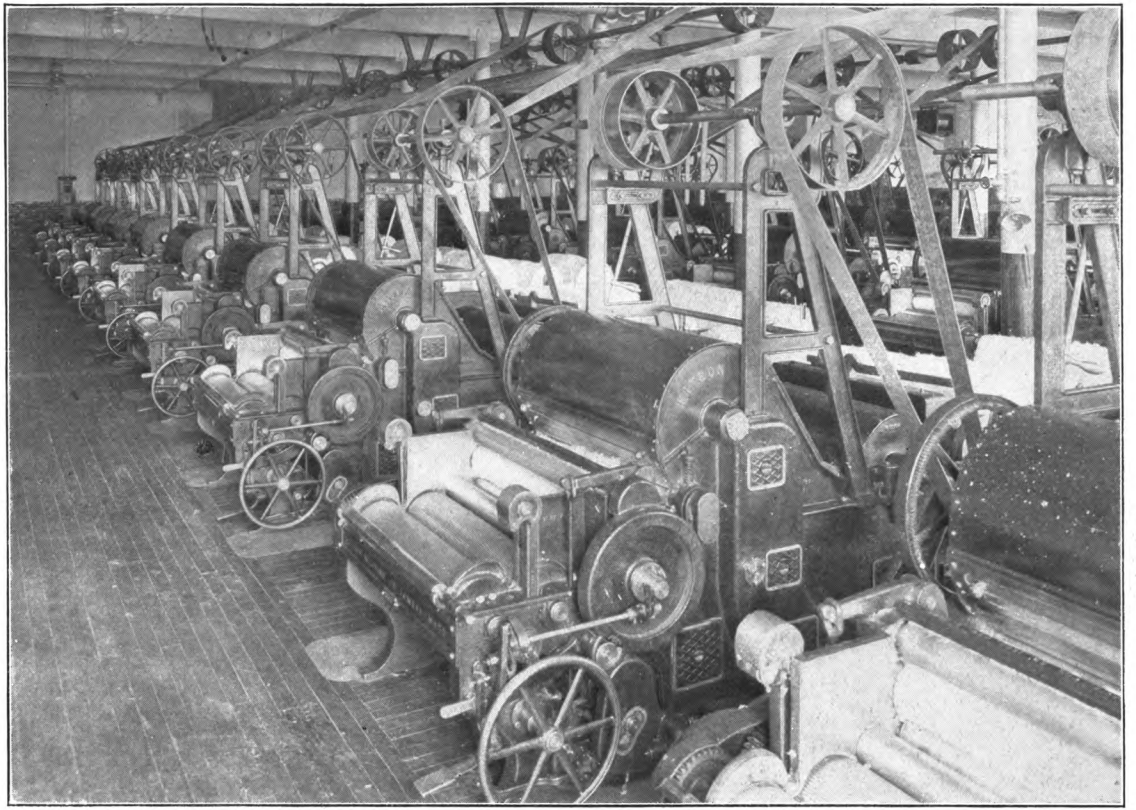

PLATE 4.—PICKER ROOM IN COTTON MILL.

This room has good ventilation and the picker machines are modern and well constructed.

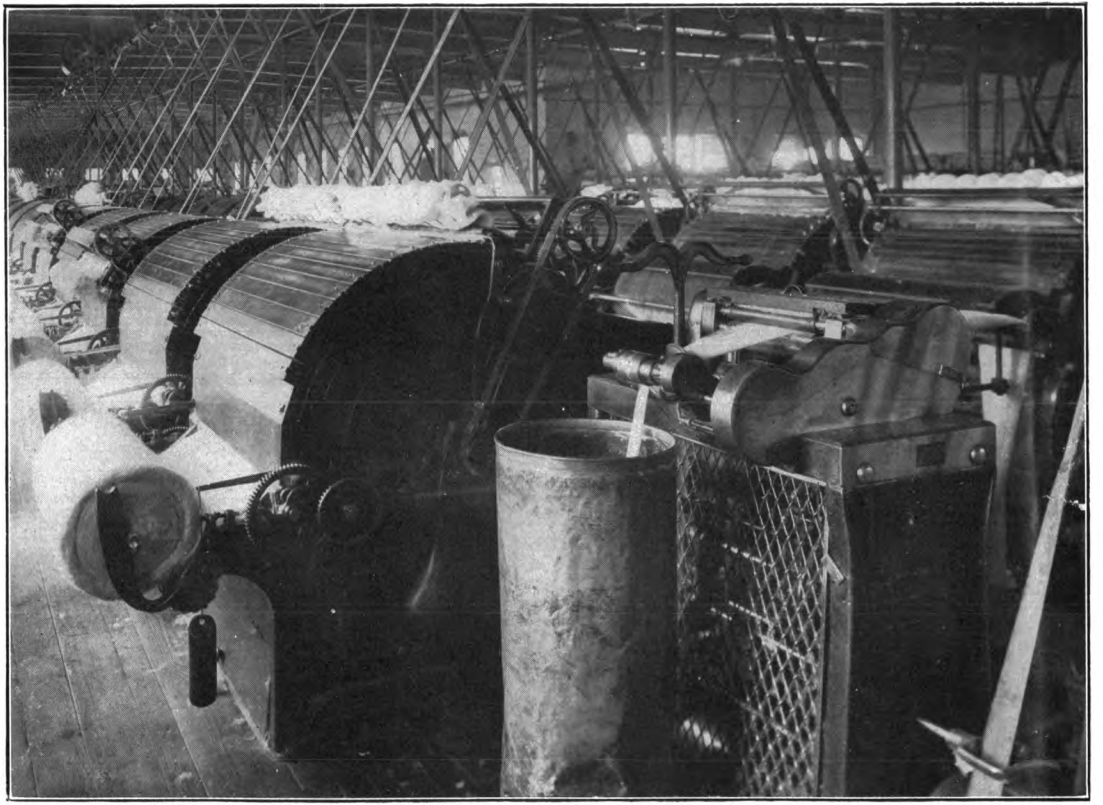

PLATE 5.—CARDING ROOM IN COTTON MILL.

This room has an old-style carding machine. The building is old and the hygienic conditions are bad. So much lint escapes as to cause a distinct haziness in the room.

PLATE 6.—CARDING ROOM IN COTTON MILL.

A model workroom with humidifying apparatus overhead and modern carding machines.

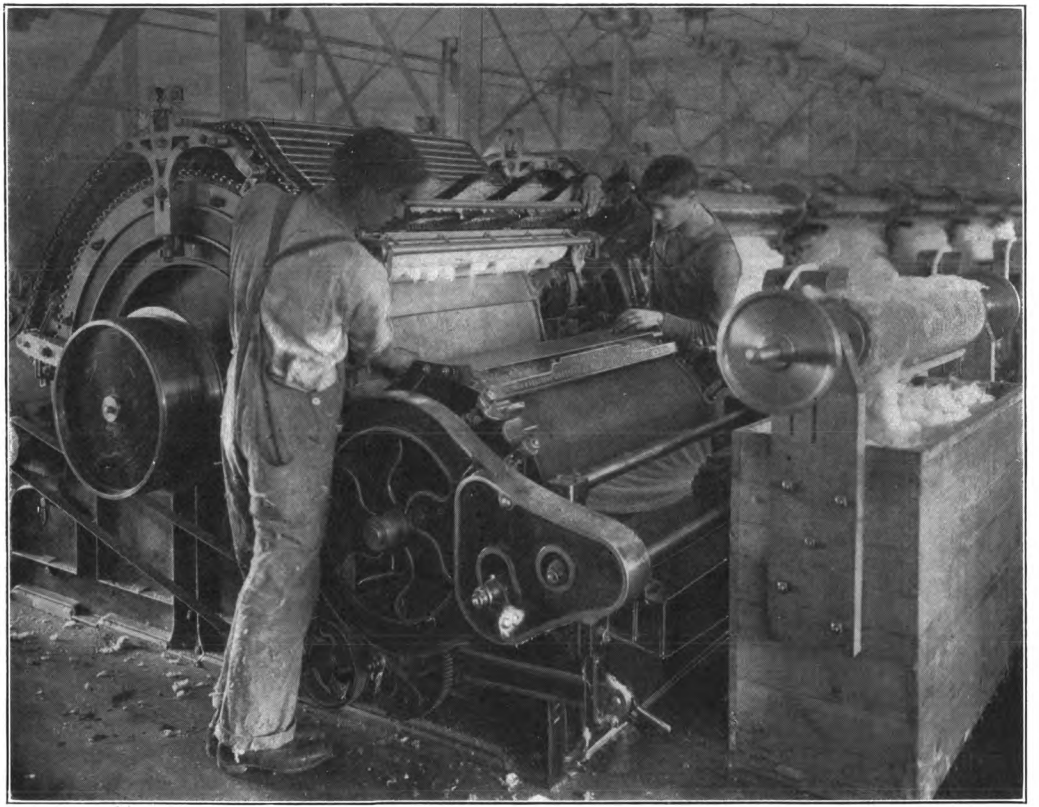

PLATE 7.—CARD STRIPPING IN COTTON MILL.

The machine shown gives rise to much cotton dust or fly. When in use the circular brush which appears over the stripping box is placed next the cylinder between the two men and scatters the dust.

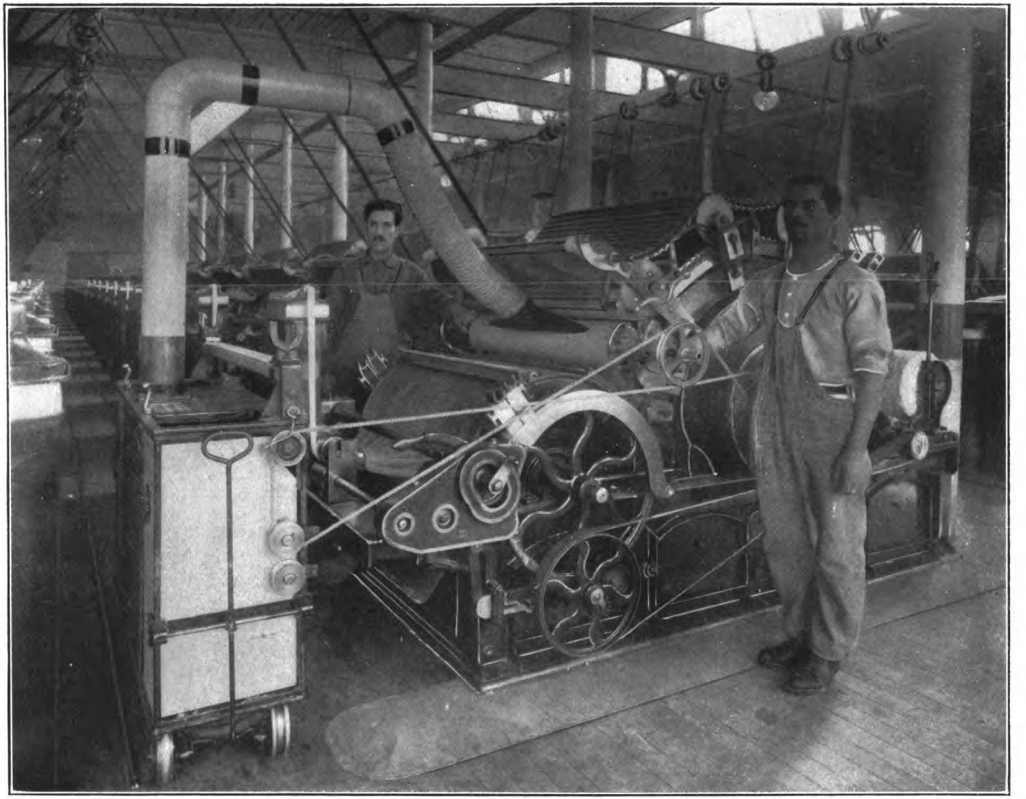

PLATE 8.—CARD STRIPPING IN COTTON MILL.

In this machine the stripping device is fitted so perfectly to the card on one end and to a dust-tight patented machine on the other that practically no dust escapes into the room.

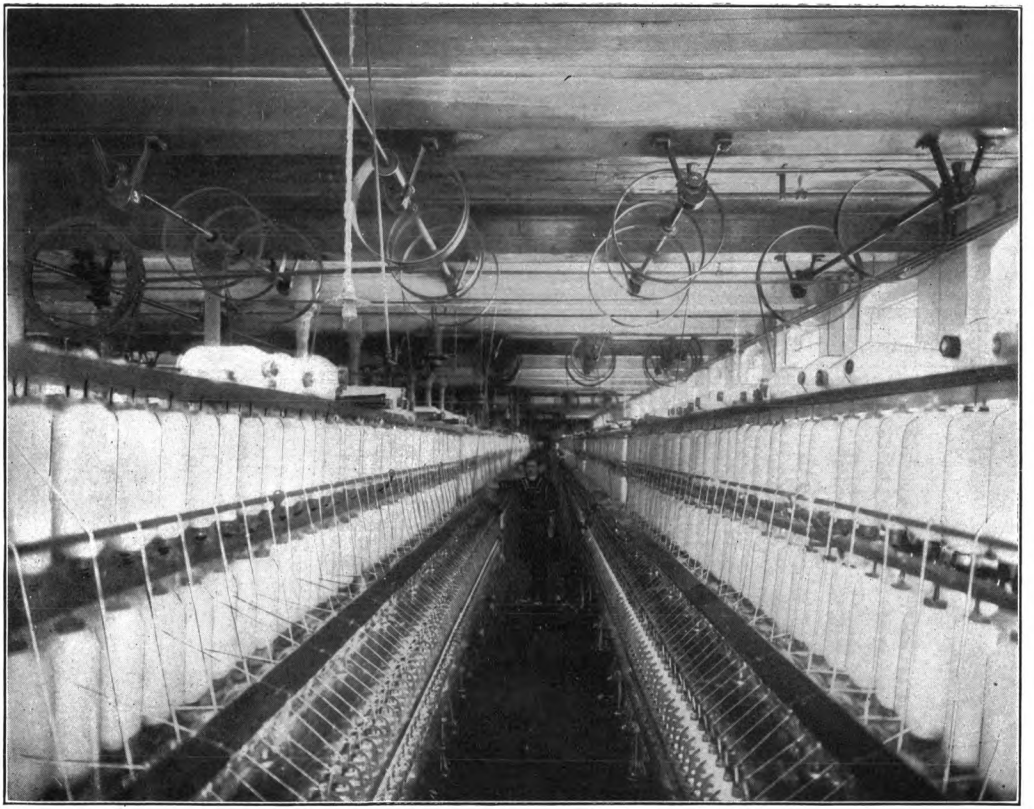

PLATE 9.—ROVING IN COTTON MILL.

The process as conducted in an old mill. The room is low studded, insufficiently lighted, and inadequately ventilated.

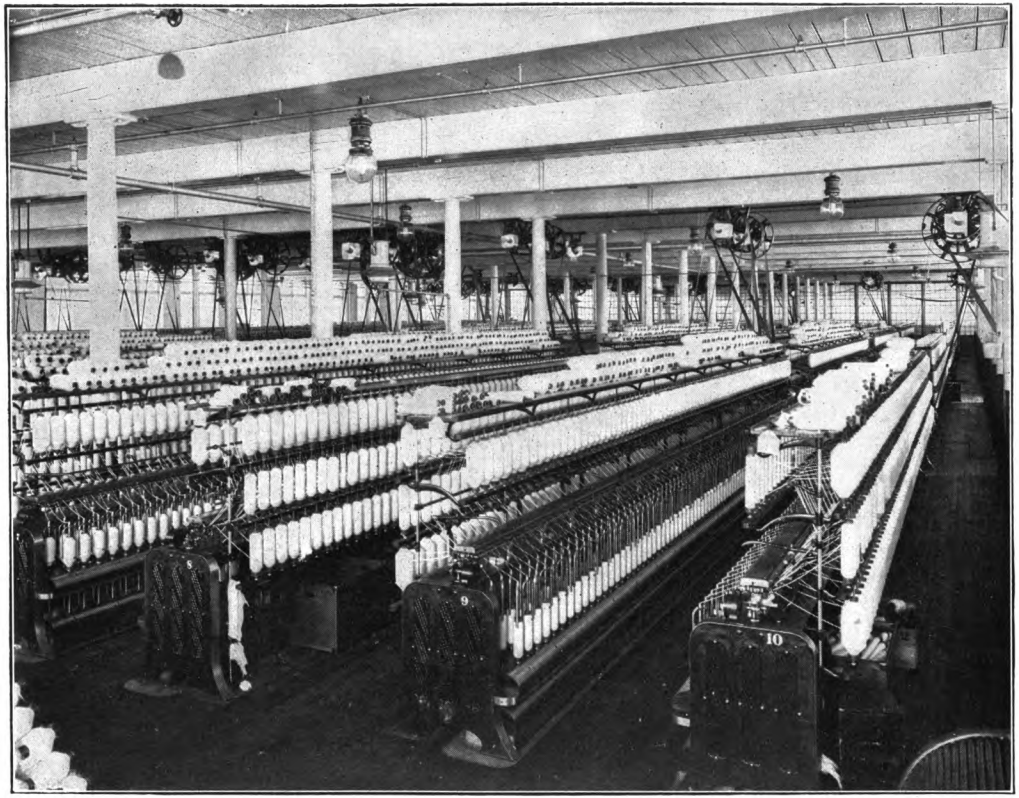

PLATE 10.—ROVING IN COTTON MILL.

The process as conducted in a modern and model workroom. Well regulated artificial humidity is used.

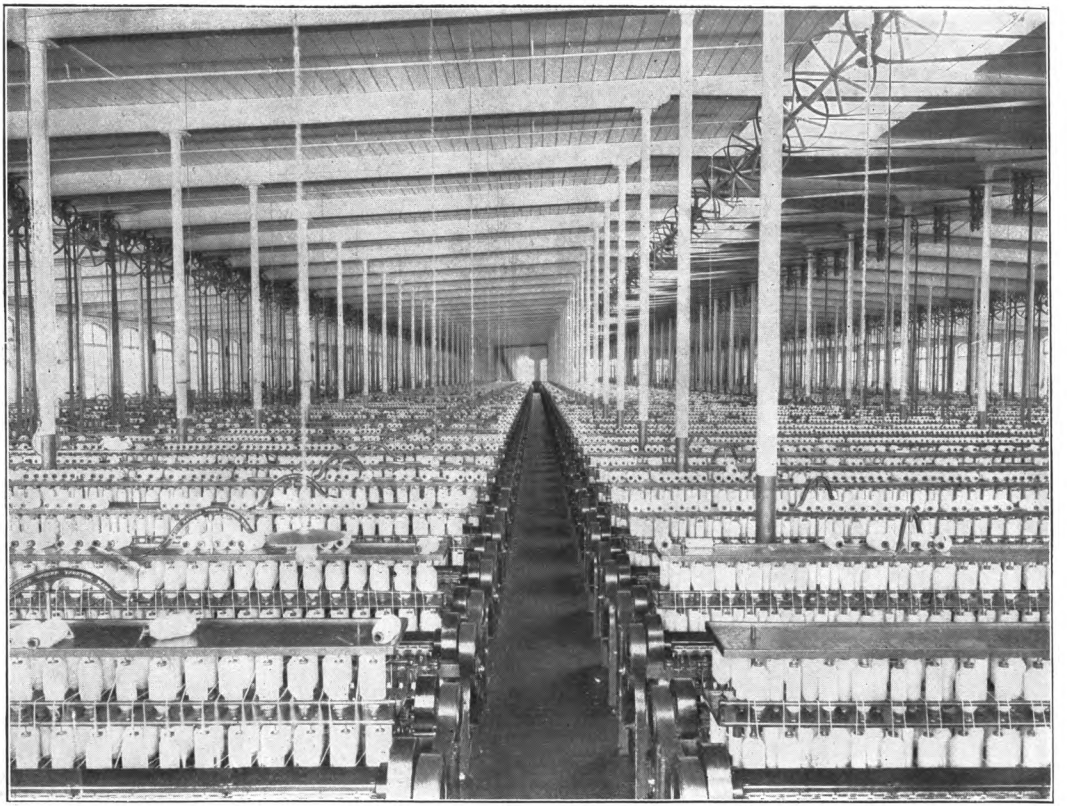

PLATE 11.—RING SPINNING IN COTTON MILL.

The room shown is well ventilated and properly heated, the windows are large, the transoms can be opened, and the walls and ceilings are high and clean.

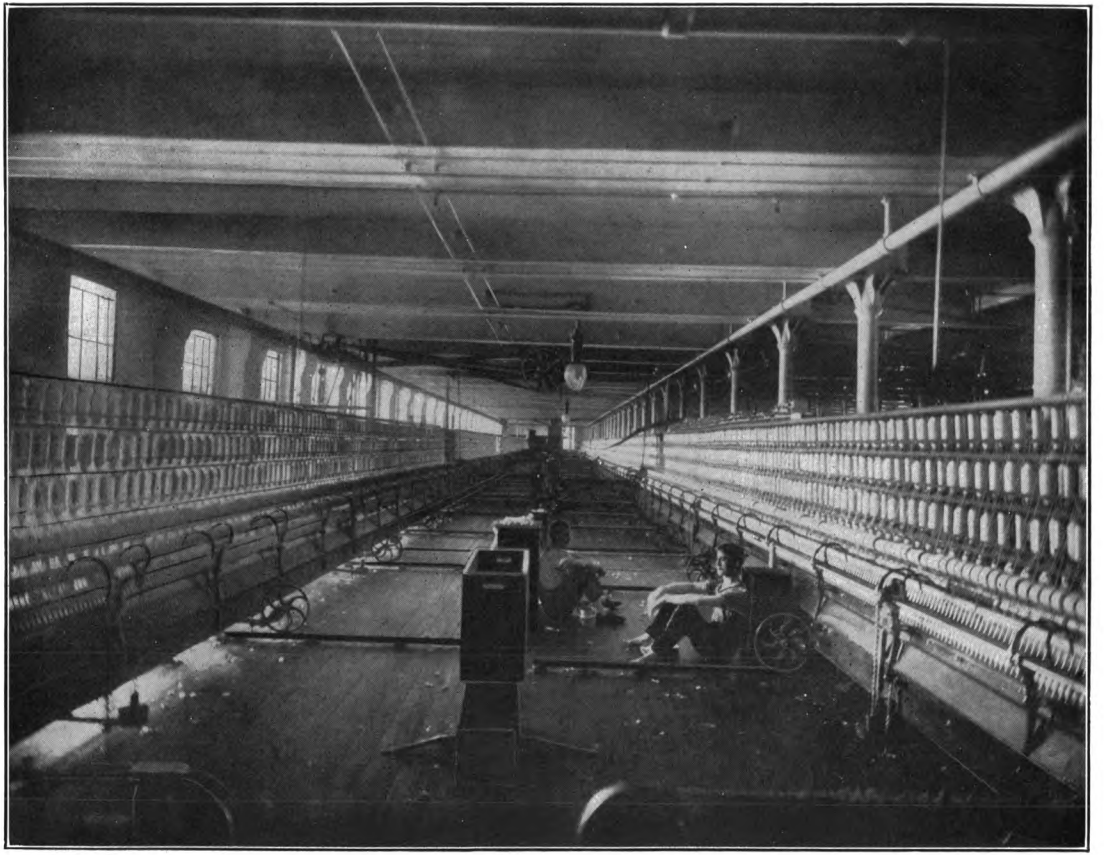

PLATE 12.—MULE SPINNING IN COTTON MILL.

An old mill building with unsatisfactory mule spinning conditions.

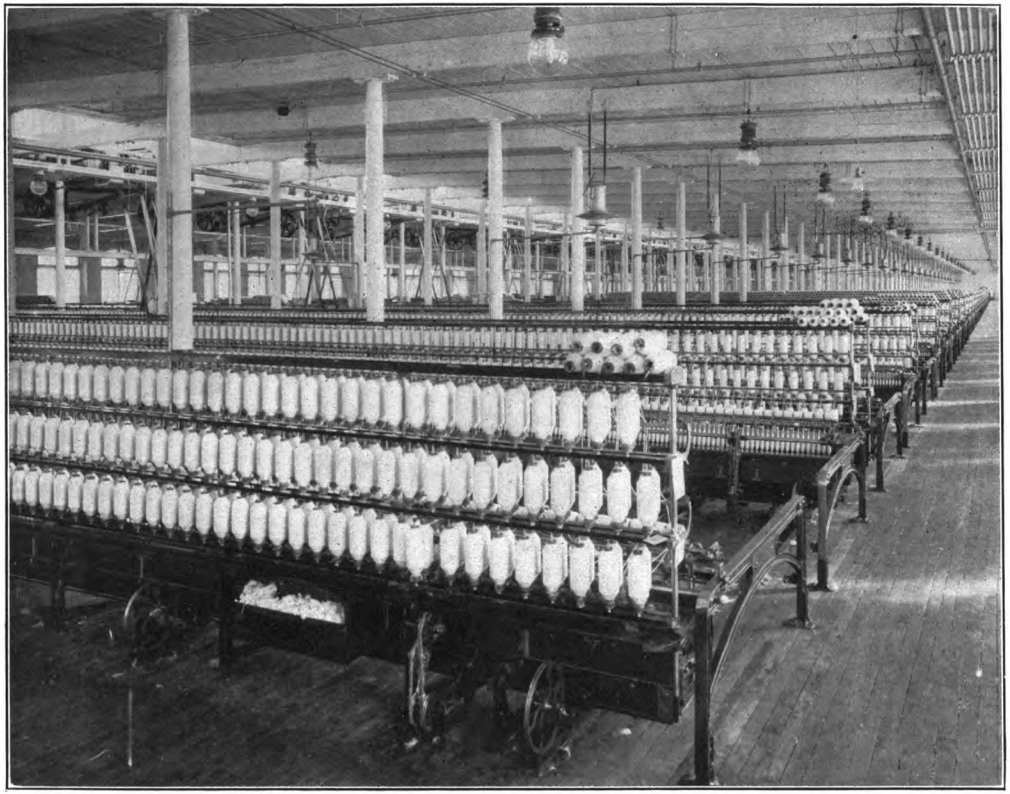

PLATE 13.—MULE SPINNING IN COTTON MILL.

A well lighted and ventilated model mule room in a modern mill.

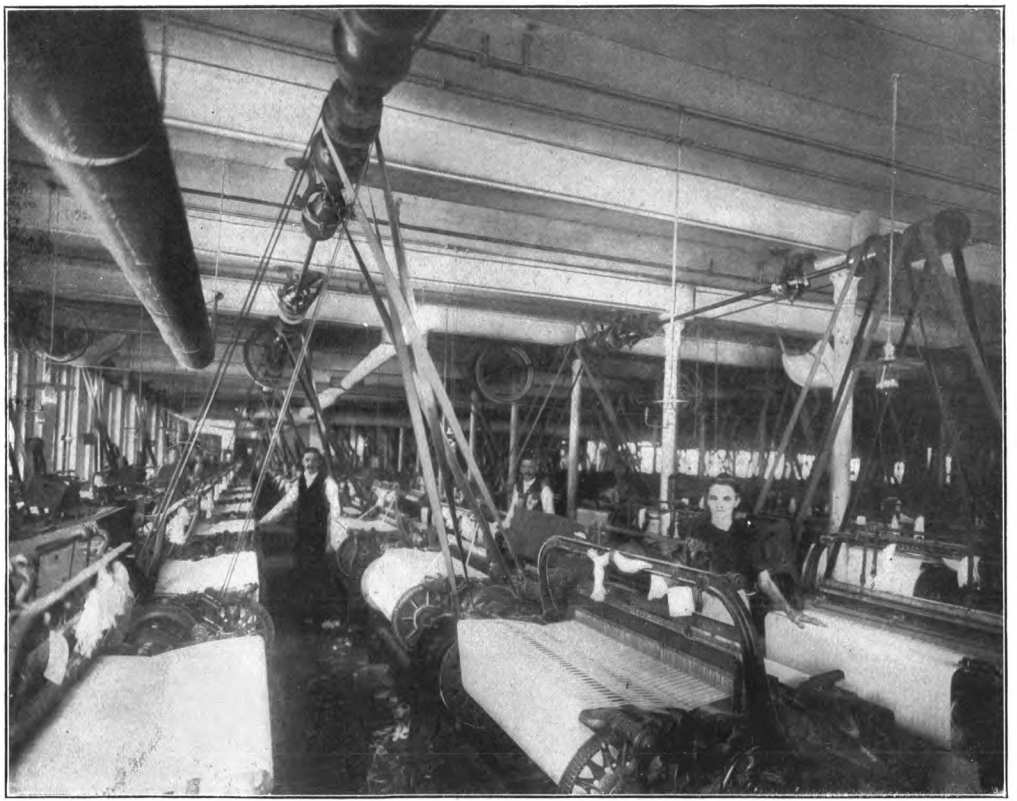

PLATE 14.—WEAVING IN COTTON MILL.

The weave room shown lacks good ventilation and proper regulation of heat and moisture.

PLATE 15.—WEAVING IN COTTON MILL.

This room has good light and ventilation and is without belts and shafting overhead.

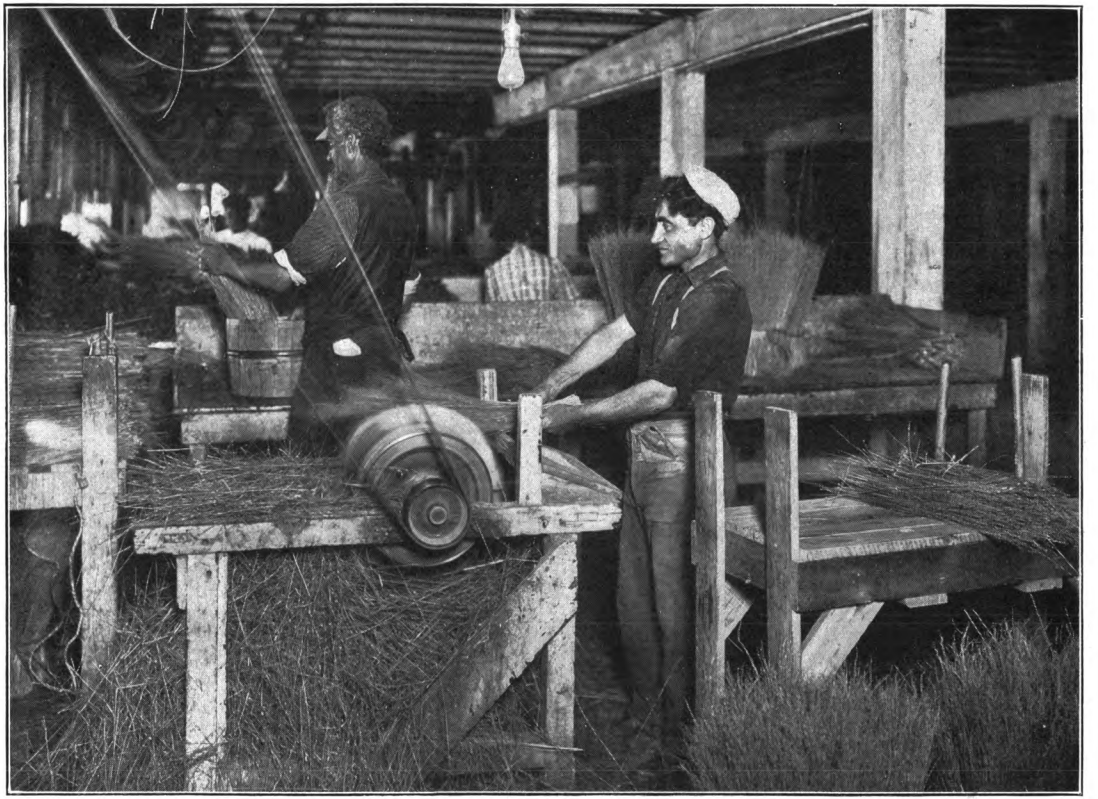

PLATE 16.—COMBING BROOM CORN.

A revolving drum from which nails project combs out the small pieces of corn, giving rise to much dust and seed.

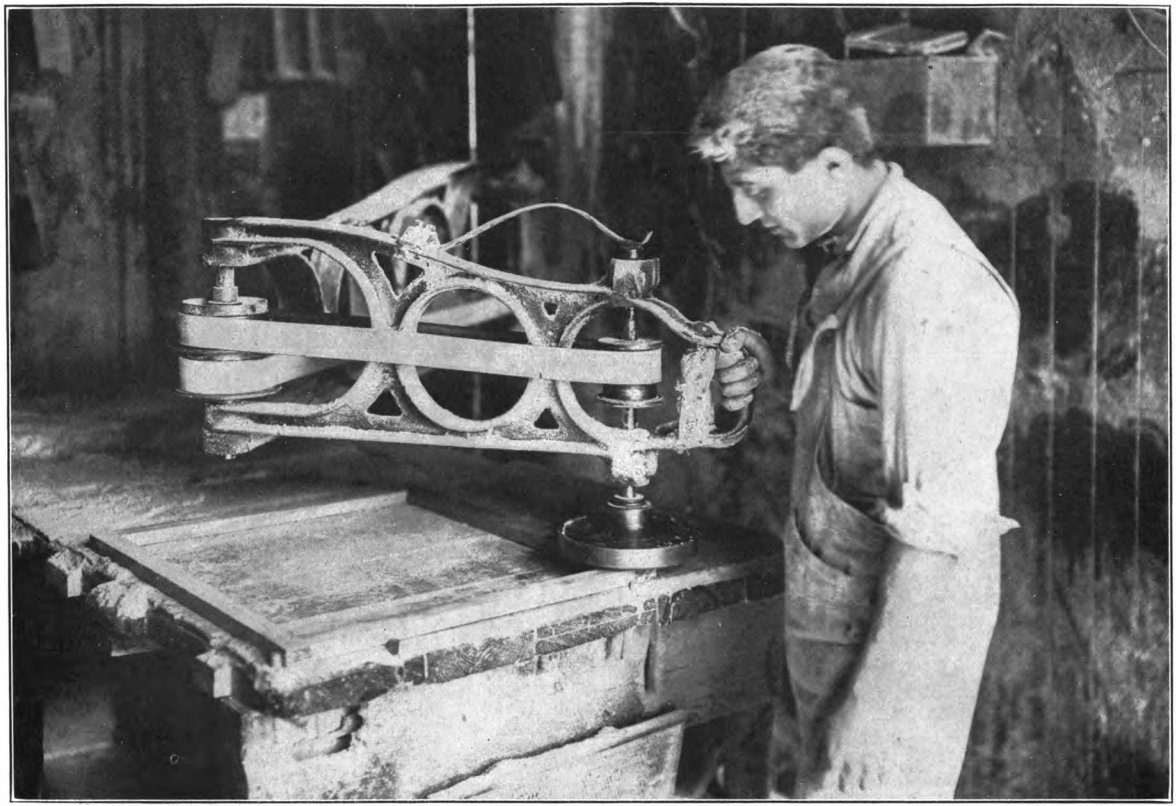

PLATE 17.—PLANING WOOD FRAMES.

The action of the sandpaper on the hard wood produces a fine white dust from which the workman is unprotected.

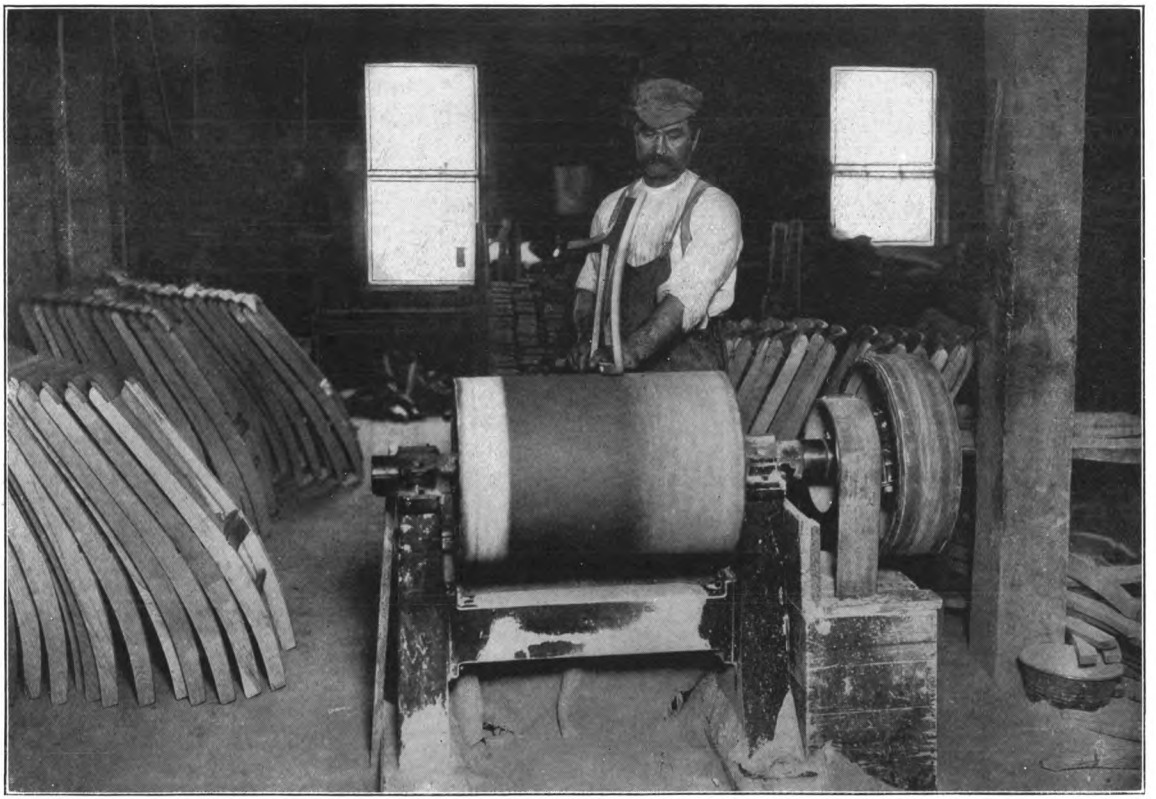

PLATE 18.—MANUFACTURE OF CHAIRS.

The revolving cylinder is covered with a composition of sand and glue, producing fine dust when in contact with the wood. The room shown has no dust-removal device for the protection of employees.

PLATE 19.—MANUFACTURE OF CHAIRS.

The exhaust suction pipe and hood shown in connection with the cylinder gives the employee considerable protection against dust.

PLATE 20.—ROUNDING AND POINTING HAIRPINS.

No dust-removal device is here provided for the protection of employees.

PLATE 21.—POINTING TEETH OF CELLULOID COMBS.

An effective dust-removal system for prevention of fire and protection of health.

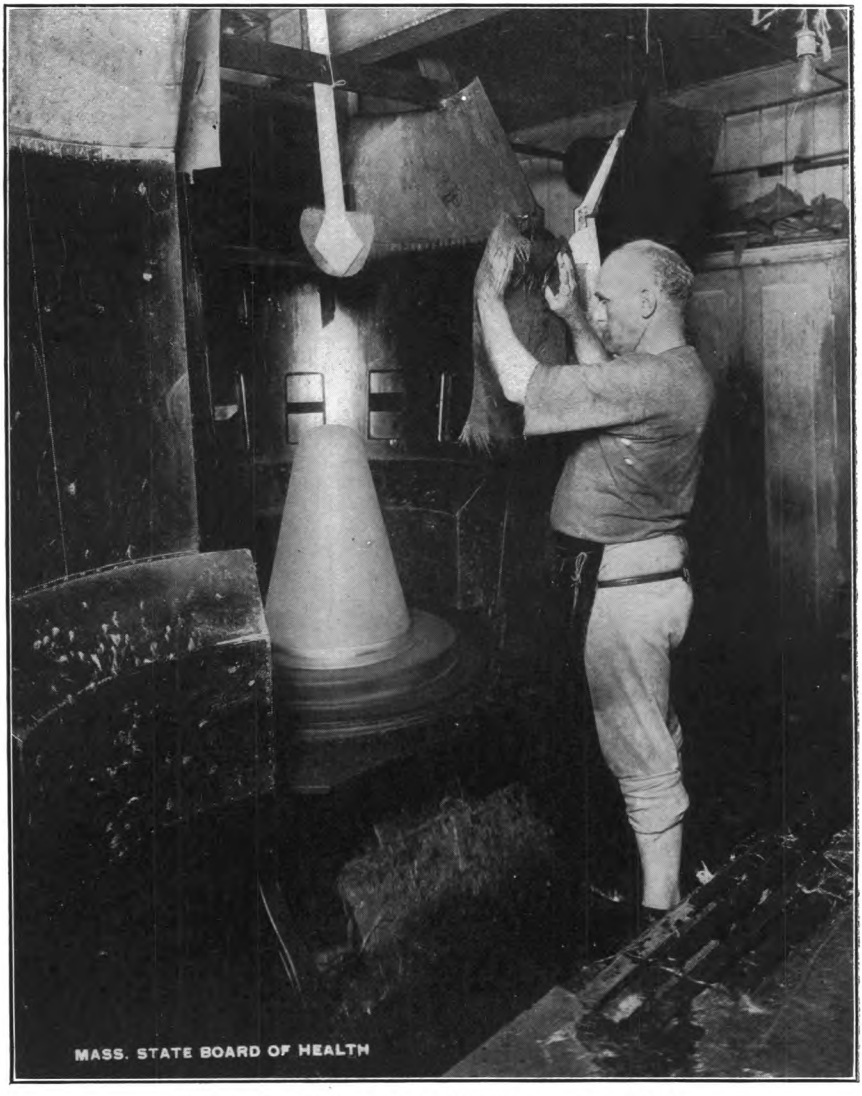

PLATE 22.—WORKMAN ATTENDING FELT MACHINE.

A perforated revolving cone is inclosed in a barrel-like covering open at the top and capable of being opened at the side. Fine fur blown into the top of the inclosure is deposited on the cone by means of suction. The workman is exposed to much fine dust.

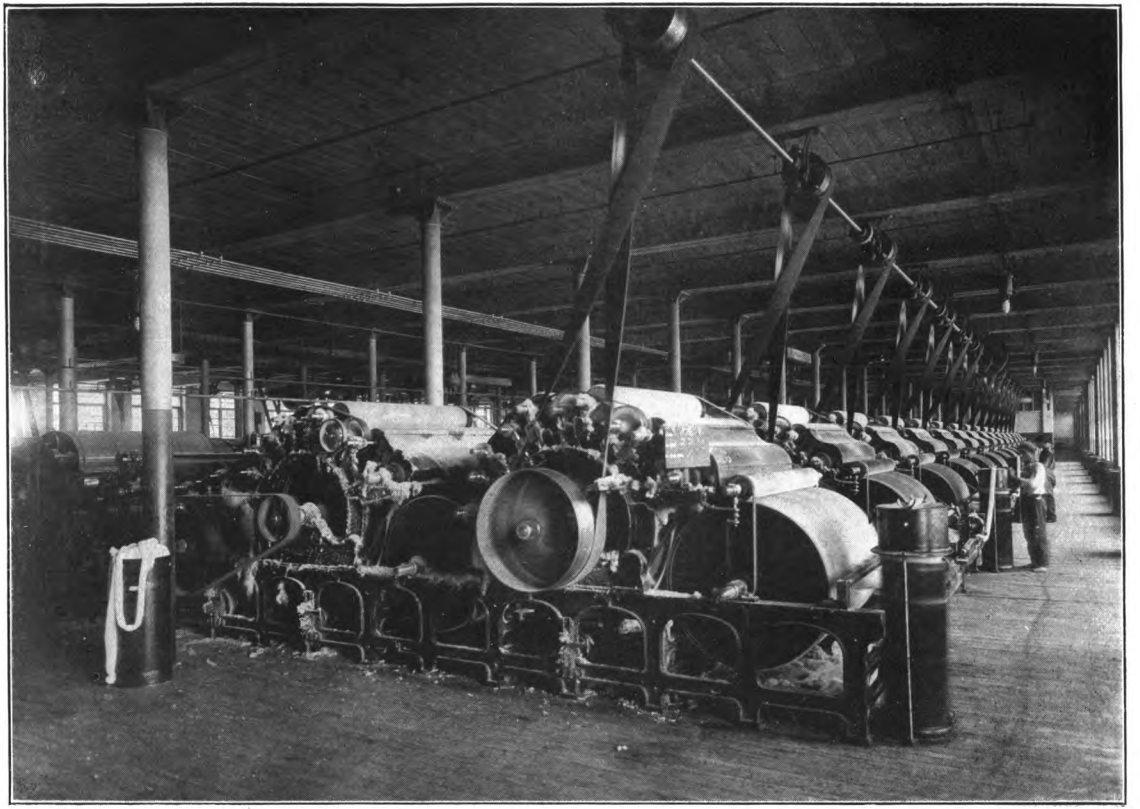

PLATE 23.—CARDING ROOM IN WOOLEN MILL.

A modern workroom with practically ideal sanitary conditions.

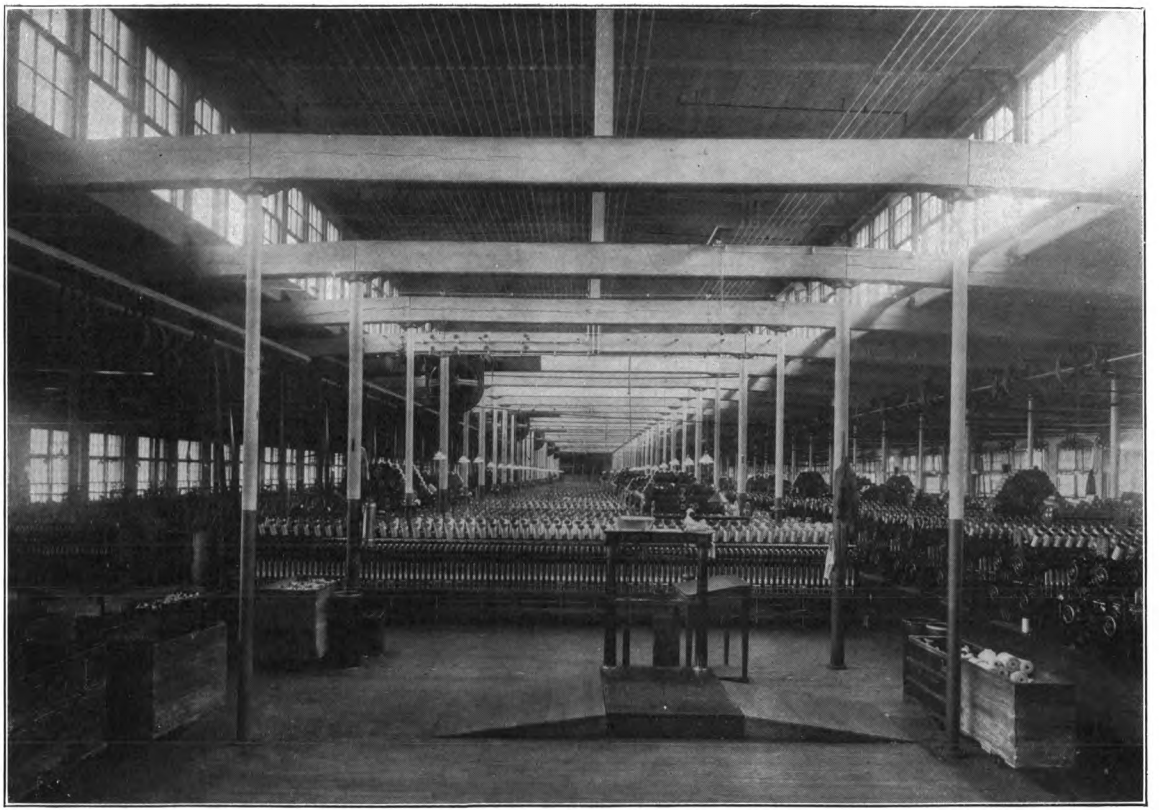

PLATE 24.—SPINNING ROOM IN WOOLEN MILL.

A modern workroom with practically ideal sanitary conditions.

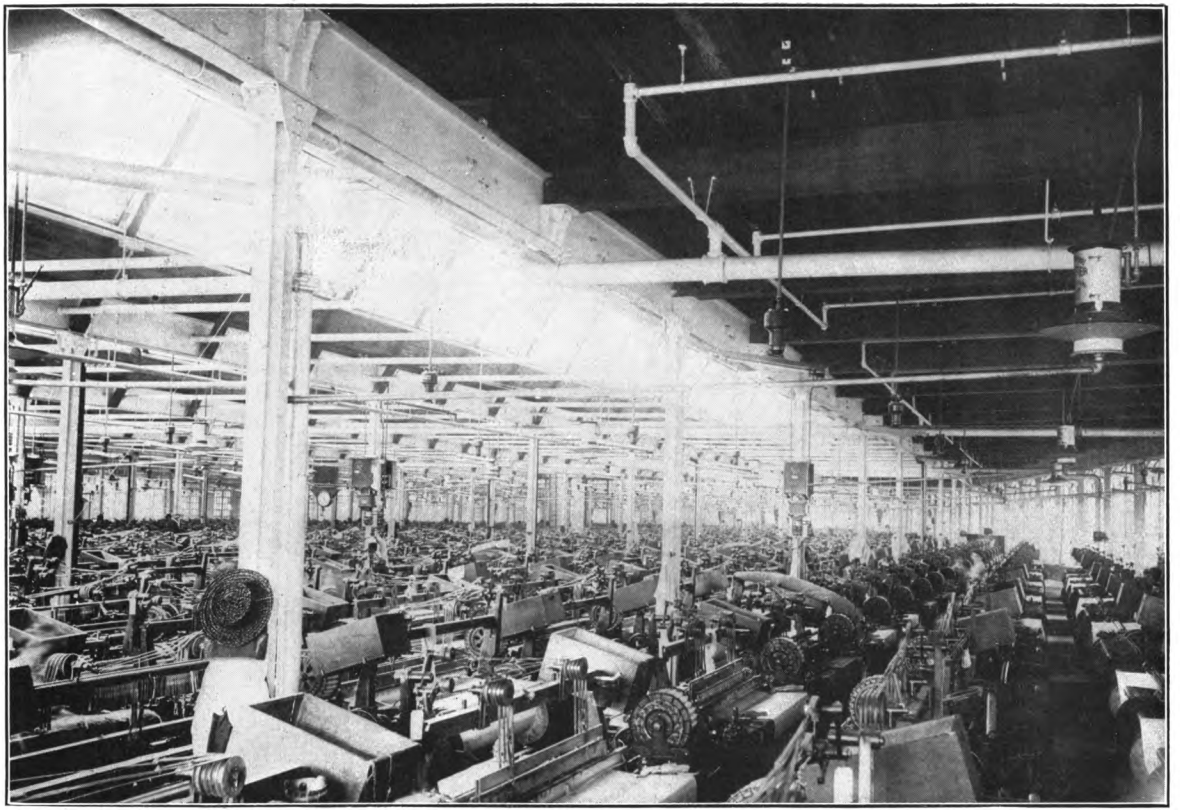

PLATE 25.—WEAVING ROOM IN WOOLEN MILL.

A modern workroom with practically ideal sanitary conditions.

PLATE 26.—EDGE TRIMMING IN SHOE FACTORY.

The dust-removal system here shown is clogged and ineffective.

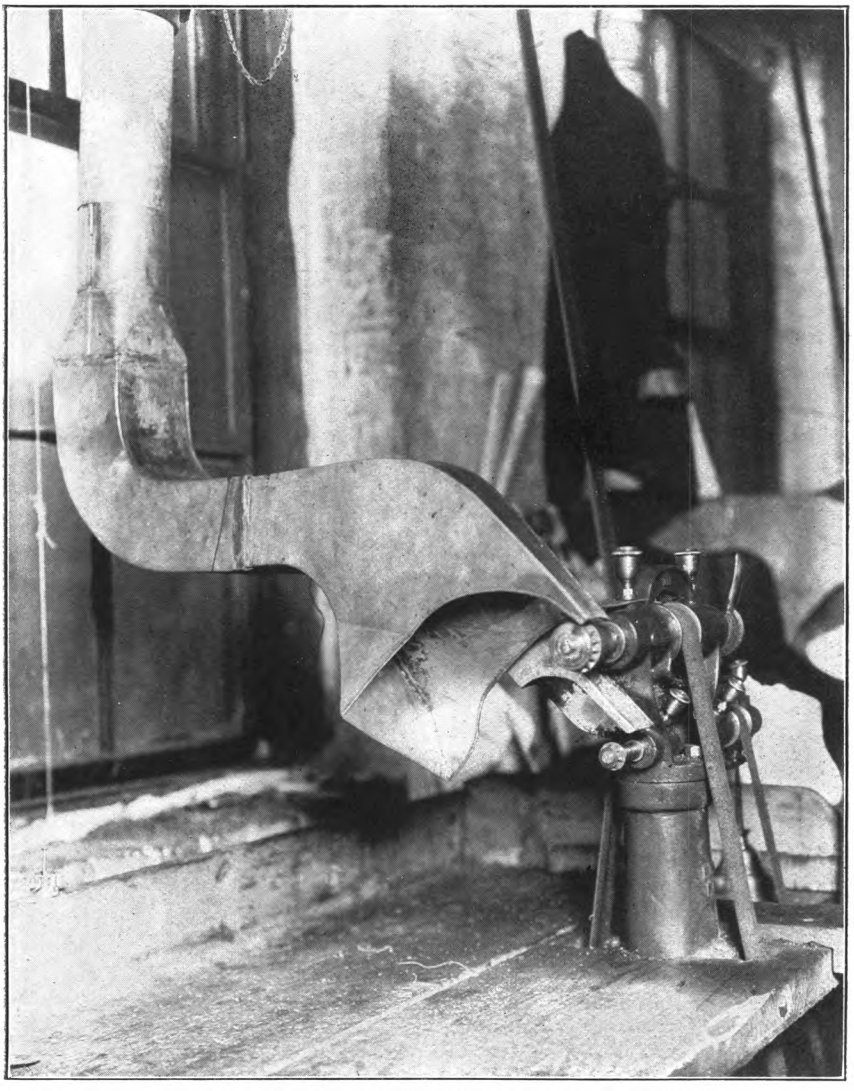

PLATE 27.—EDGE TRIMMING IN SHOE FACTORY.

The dust-removal system is ample and effective.

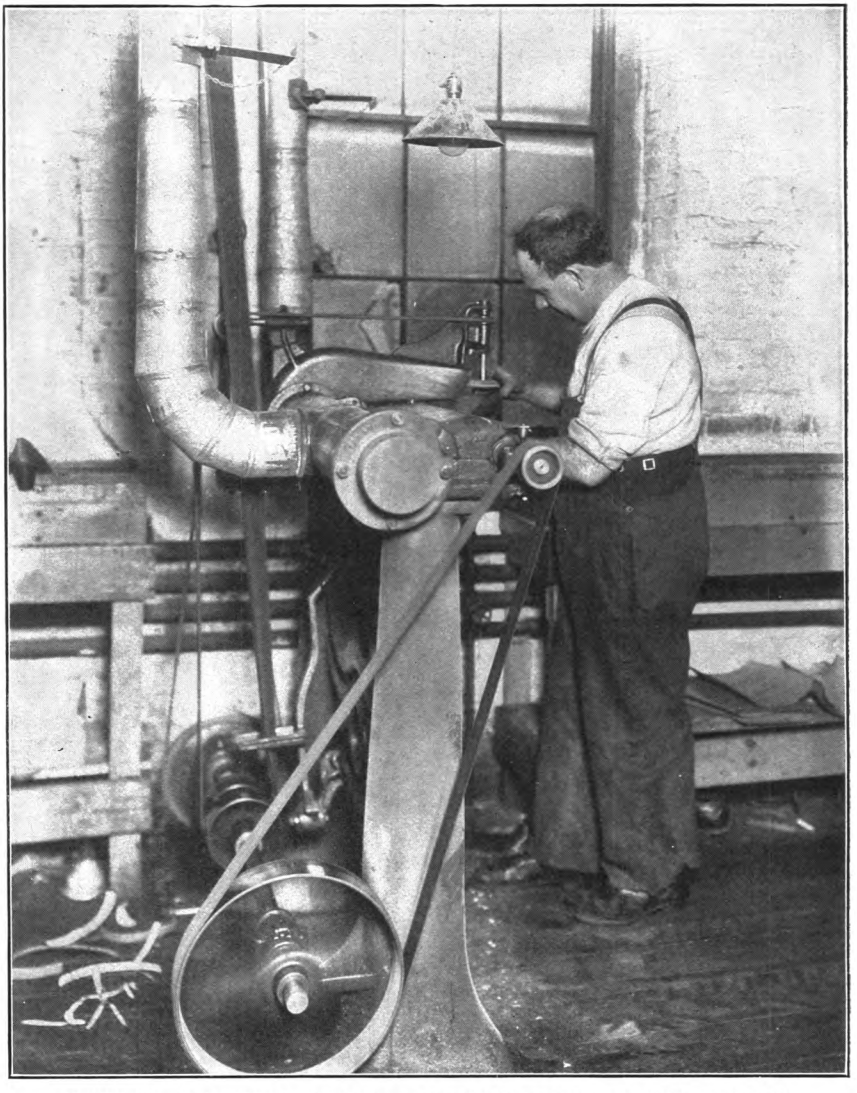

PLATE 28.—NAUMKEAG BUFFING OR NAUMKEAGING IN SHOE FACTORY.

Fine carborundum and leather dust are produced very close to the workman's head. Excellent hoods and a strong exhaust draft are here shown.

PLATE 29.—XPEDITE FINISHING MACHINE IN SHOE FACTORY.

Unless properly hooded fine particles of blacking, wax, and bristles are thrown off from this machine. One hood is out of position and was used by the workman for holding wax.

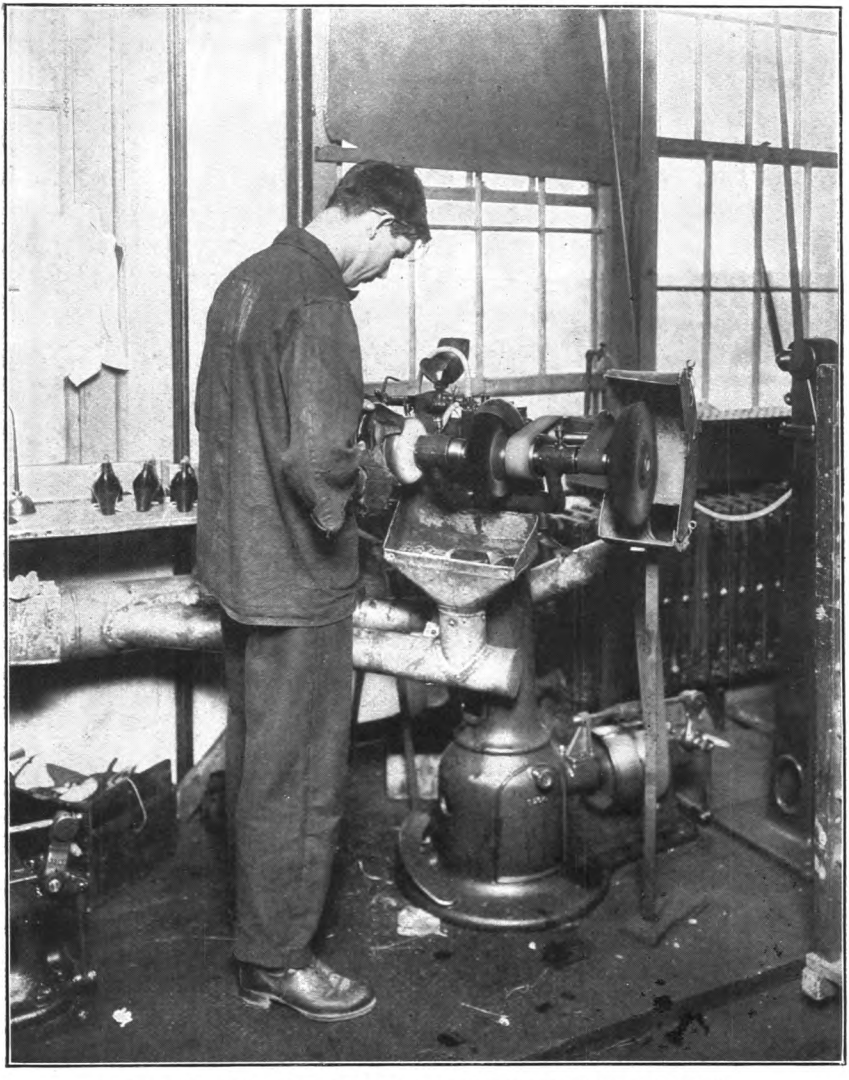

PLATE 30.—XPEDITE FINISHING MACHINE IN SHOE FACTORY.

Part of the bottom hood is used by the workman for holding wax and other materials.

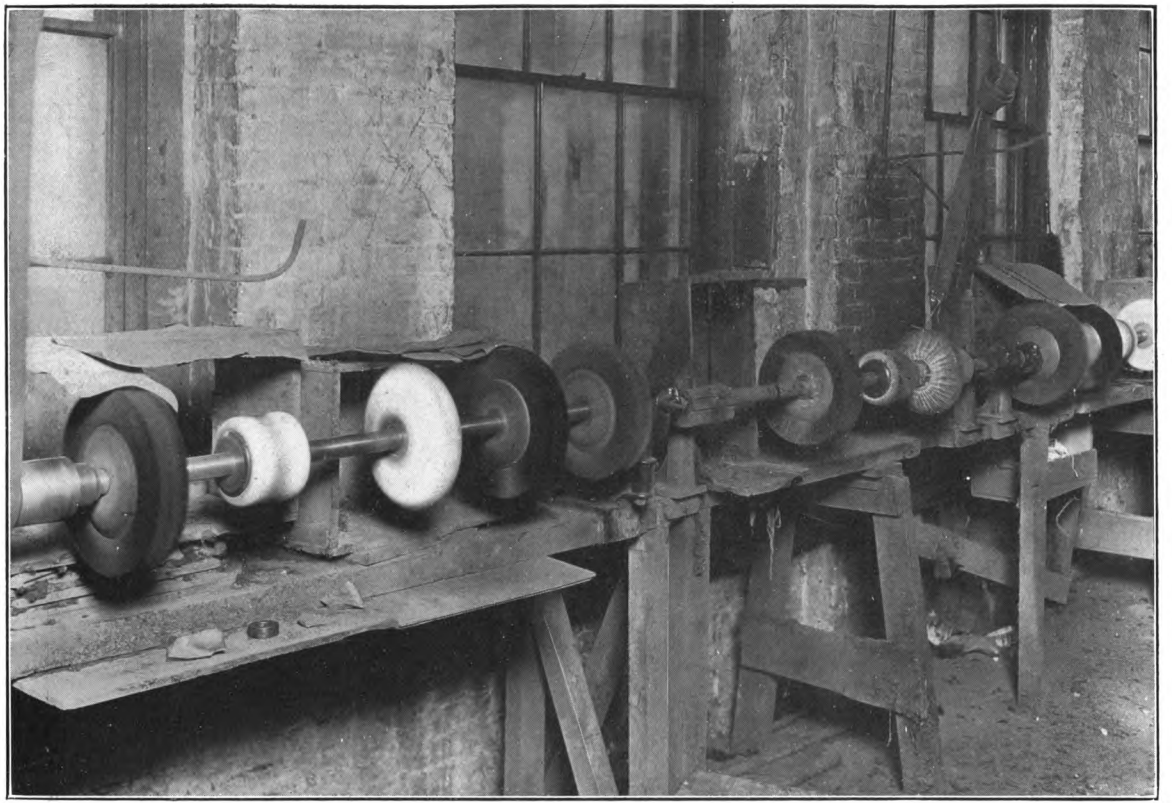

PLATE 31.—BOTTOM FINISHING OR POLISHING IN SHOE FACTORY.

Fine particles of lint, fiber, bristles, blacking, stain, and wax are given off in this operation. The picture shows the absence of any dust-removal device for the workman's protection.

PLATE 32.—POLISHING SHOES.

The makeshift hoods shown are only a crude protection against dust.

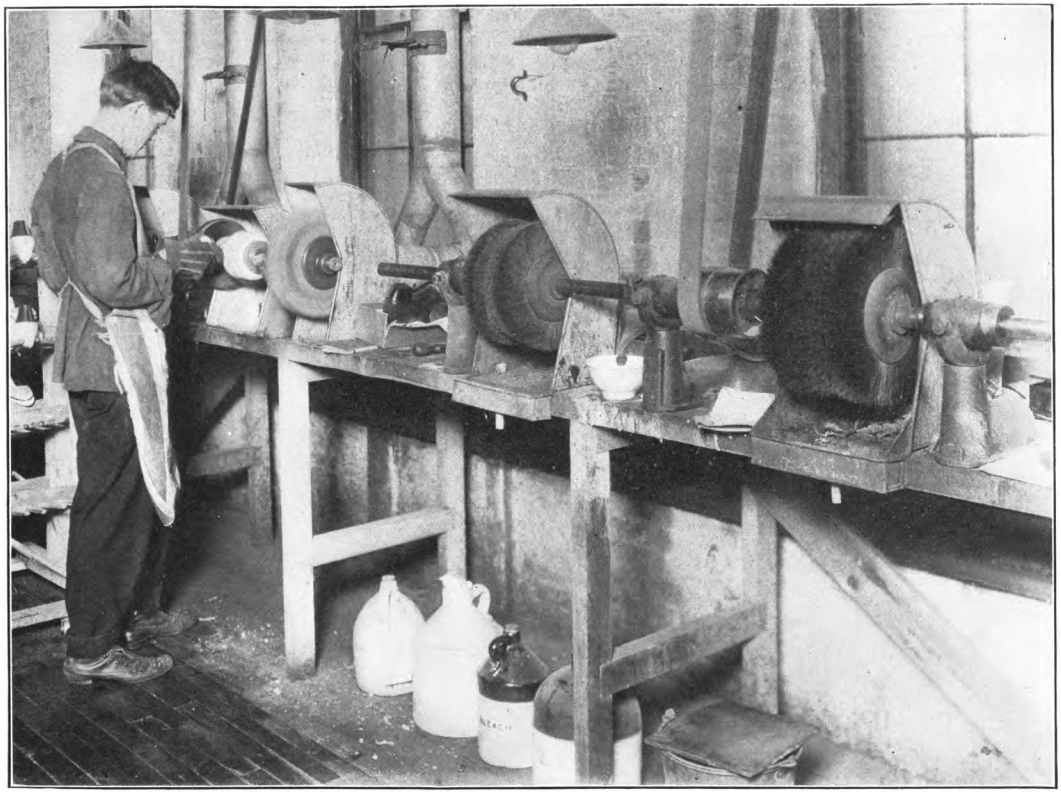

PLATE 33.—POLISHING SHOES.

The well-equipped hood and exhaust system furnishes practically ideal protection.

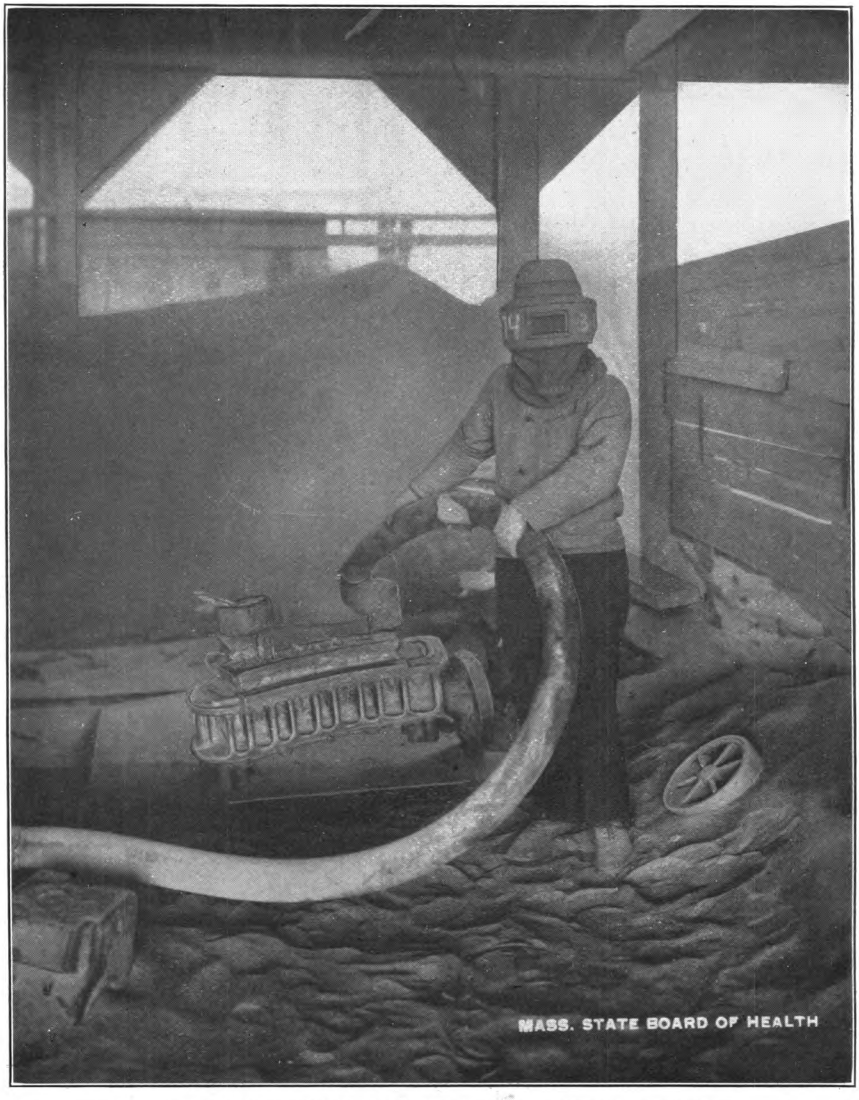

PLATE 34.—SANDBLASTING CASTINGS IN OPEN SHED.

The helmet shown does not prevent the inhalation of fine steel, iron, and brass dust.

PLATE 35.—SANDBLASTING CASTINGS IN CLOSED ROOM.

The helmet shown is connected by rubber with a tank containing compressed air. Even this does not furnish adequate protection against dust.

PLATE 36.—TUMBLING CASTINGS.

The process here shown is conducted in a closed room. In the absence of an exhaust system the workmen are exposed to an excessive amount of dust.

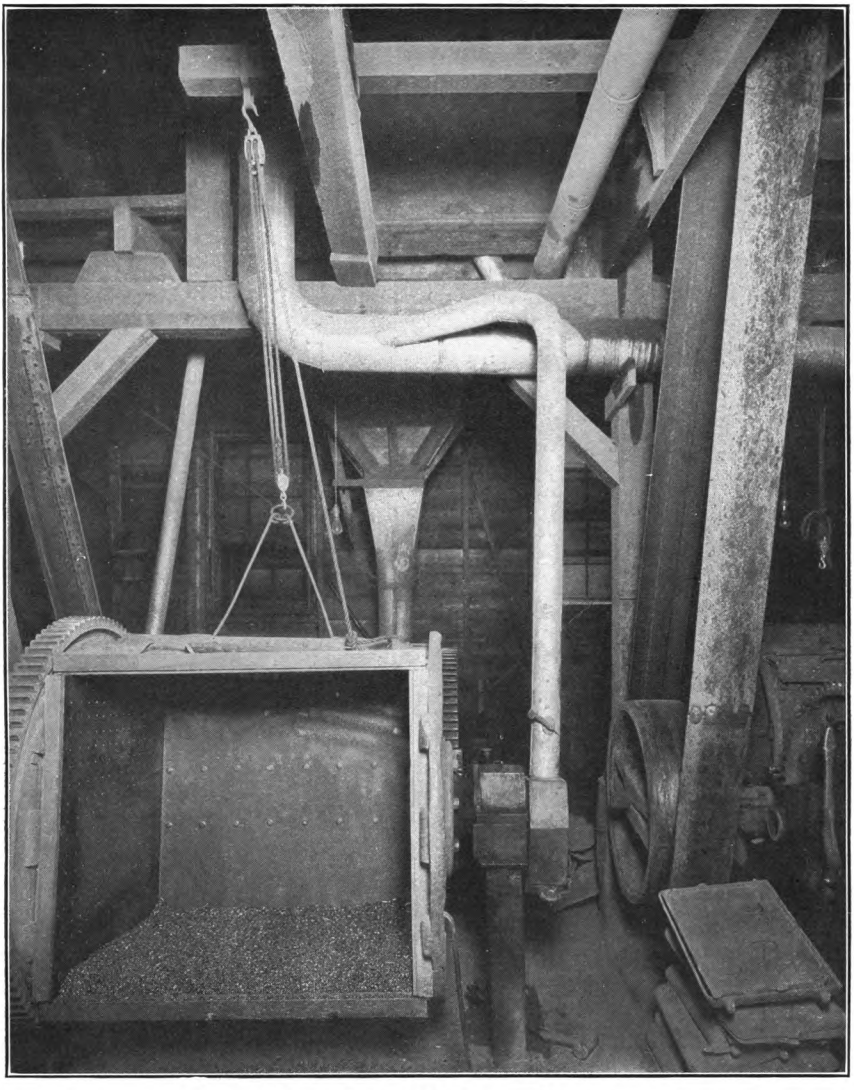

PLATE 37.—TUMBLING CASTINGS.

The tumblers shown are of very tight construction, adequately ventilated by fans, and productive of no dust whatever.

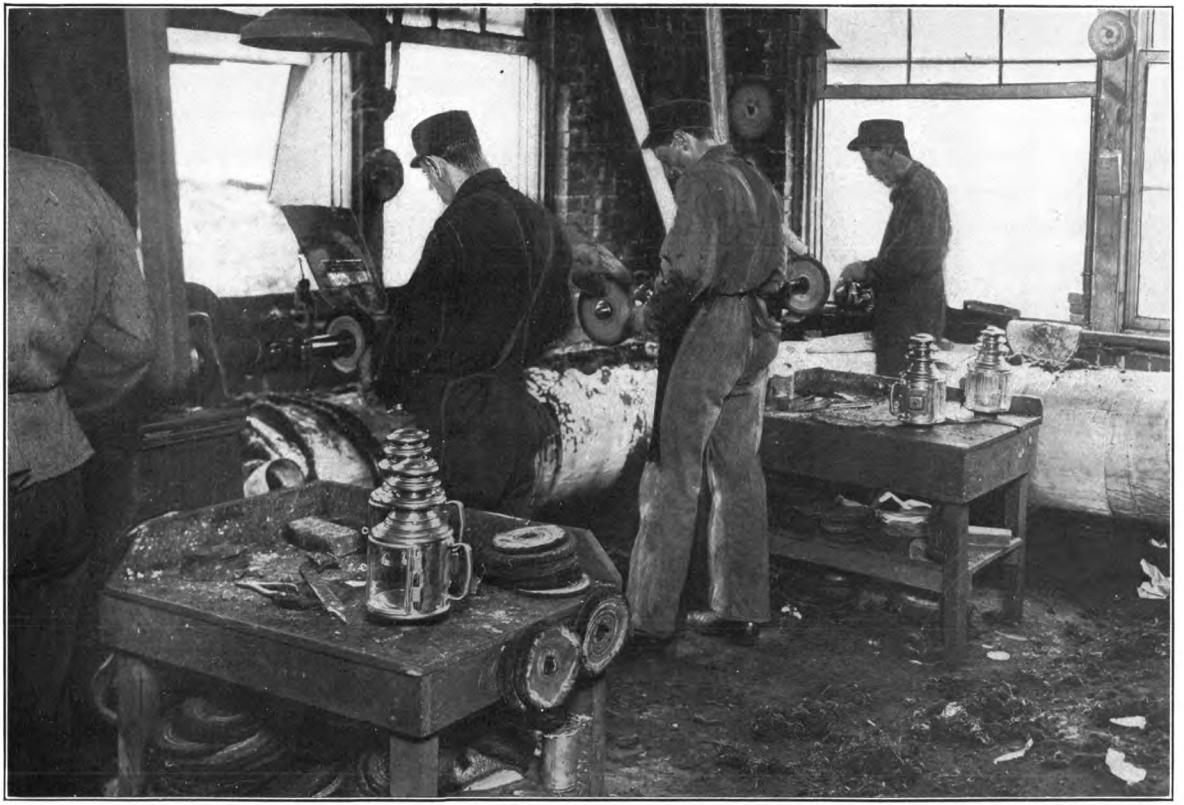

PLATE 38.—BUFFING BRASS.

No dust-removal device is here provided for the protection of employees.

PLATE 39.—BUFFING BRASS.

The buffing wheels shown are well equipped with hoods and blowers and give off pract'cally no dust or lint.

PLATE 40.—GRINDING STEEL CASTINGS ON EMERY WHEELS.

The wheels are almost completely covered with heavy iron hoods which afford good protection against dust.

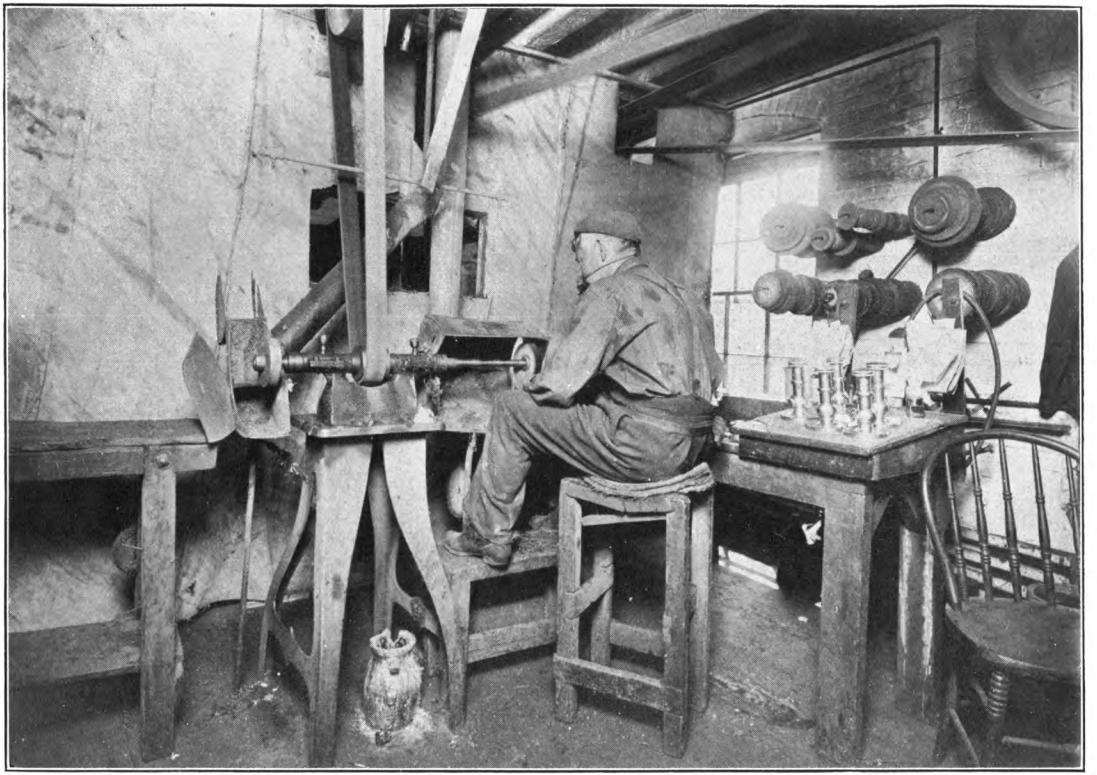

PLATE 41.—BRASS OR NICKEL POLISHING.

This man polishes brass or nickel on cotton buff balls and sometimes does emery polishing. He has tuberculosis and wears a sponge over his mouth for a respirator. The jar shown was used as a cuspidor. A canvas partition with mica windows is used to separate him from other employees. The hood and exhaust system are not altogether effective.

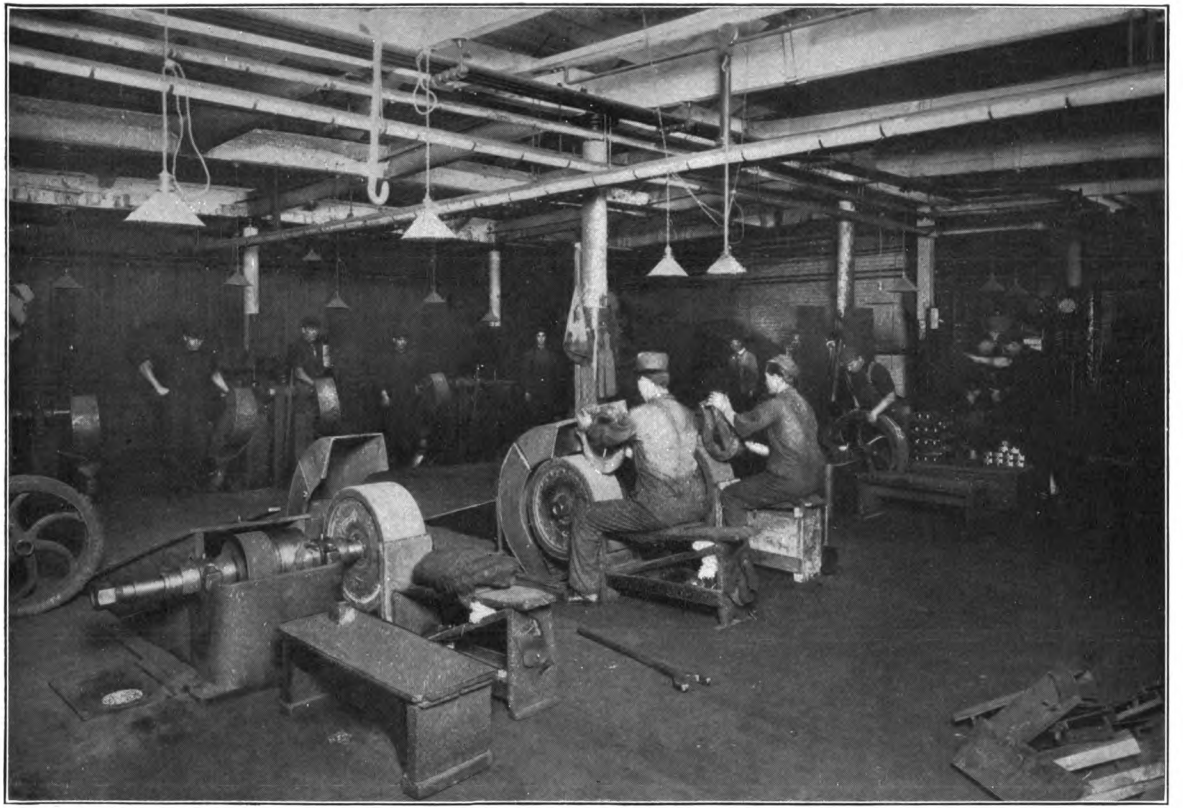

PLATE 42.—GRINDING IRON CASTINGS ON HEAVY EMERY AND CARBORUNDUM WHEELS.

Adjustable hoods are used for different-sized castings. The dust is removed by downward suction and the belting is boxed in, preventing the escape of considerable dust.

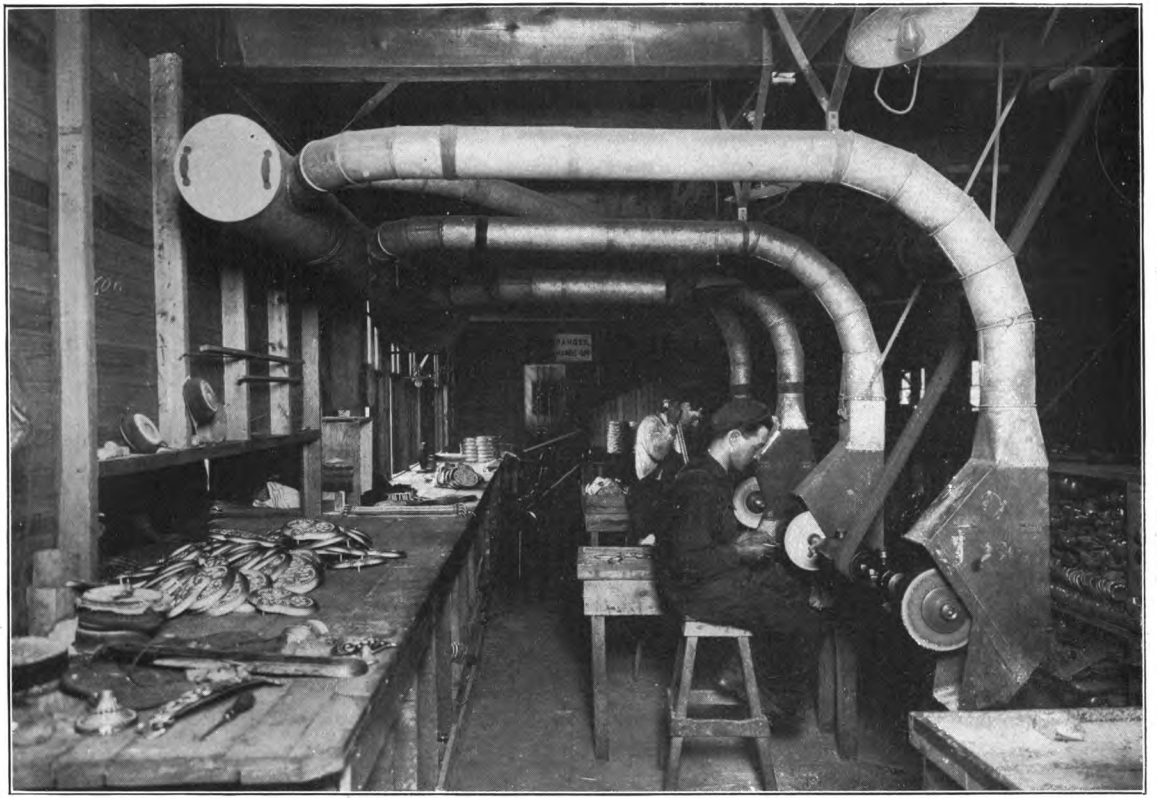

PLATE 43.—GRINDING IRON CASTINGS ON EMERY WEEELS.

The dust-removal system shown is effective and protects the workmen to a great extent from flying dust.

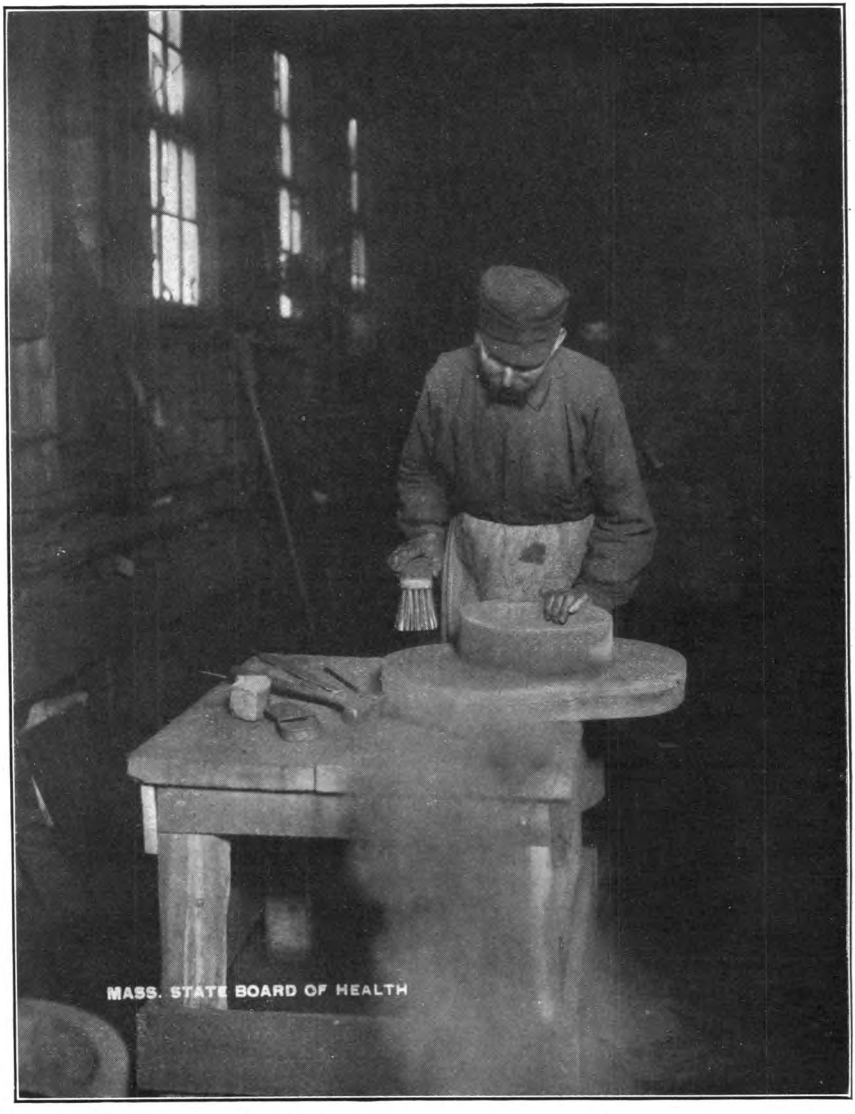

PLATE 44.—CLEANING IRON CASTINGS.

The workman is exposed to an excessive amount of dust.

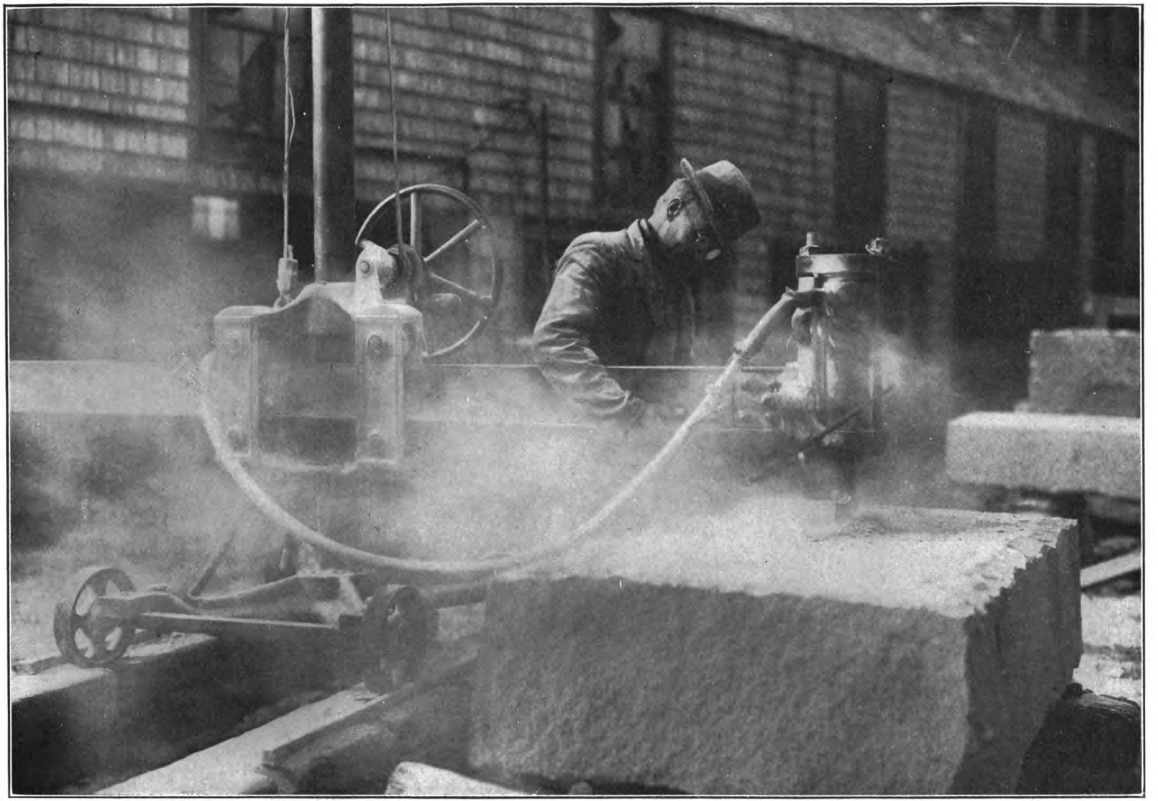

PLATE 45.—STONE CUTTING.

The strong blast of air gives rise to much dust. In rare instances the men who operate the surfacing tools wear wire masks. Some wear glasses, and some protect themselves from flying chips by the use of wire screens placed about the hammer.

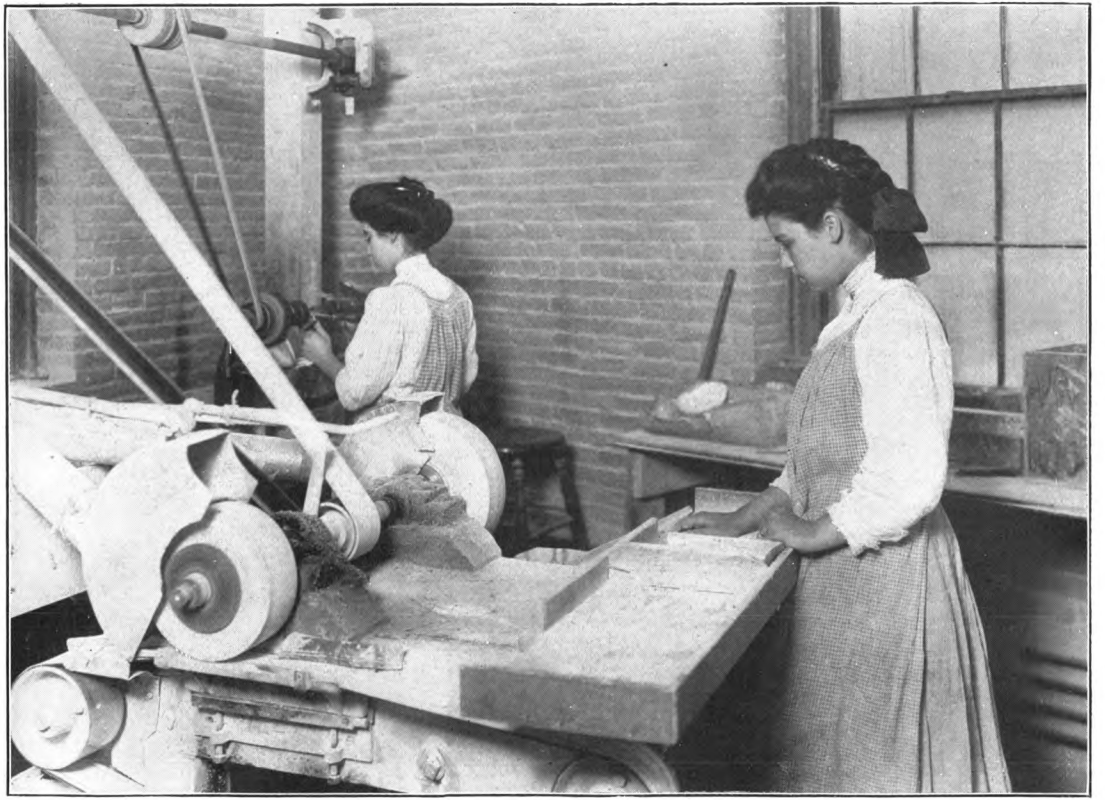

PLATE 46.—PEARL BUTTON MAKING.

The girl in the foreground places pearl disks on a belt running beneath the revolving wheel; the other girl drills holes in the disks. The exhaust system for removing the dust is ineffective.

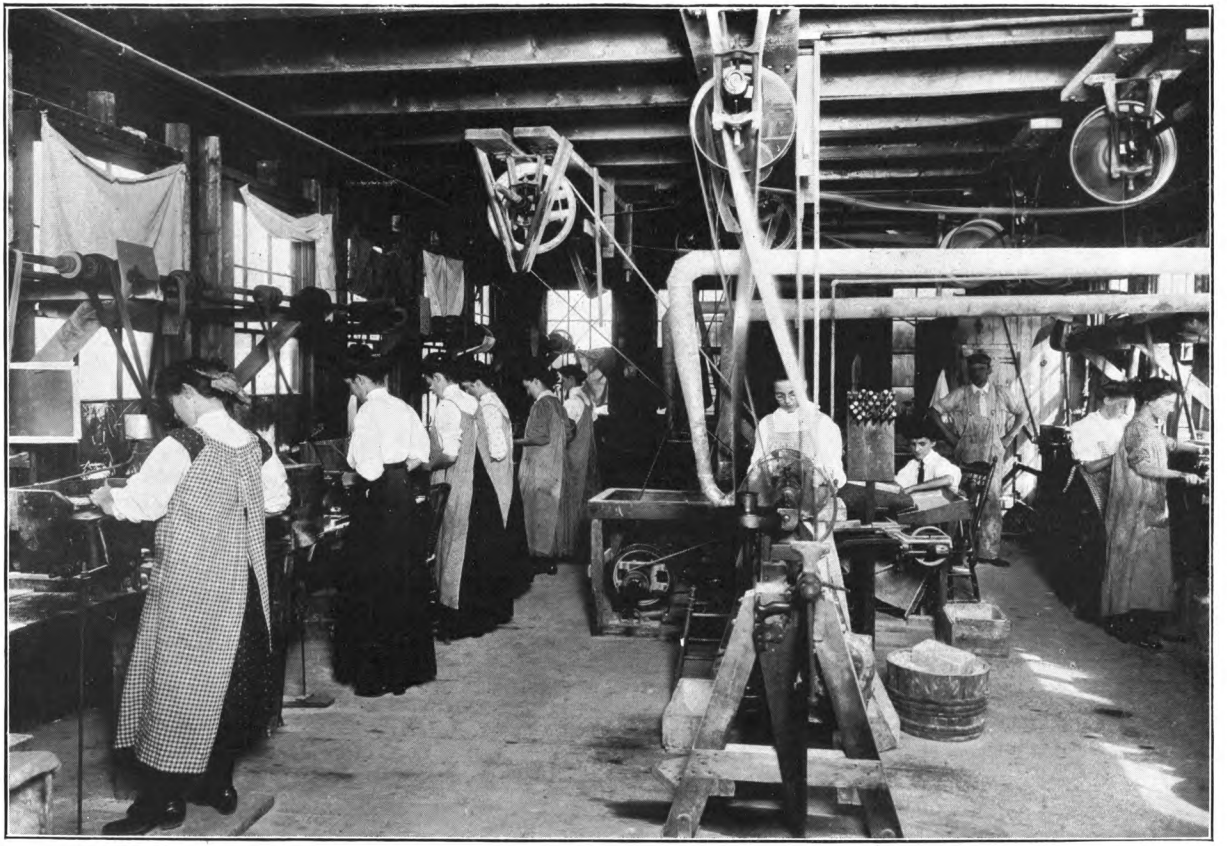

PLATE 47.—FACING, GRINDING, POLISHING, AND DOMING PEARL SHELL.

The girls are exposed to considerable dust, even with an apparently effective exhaust system.

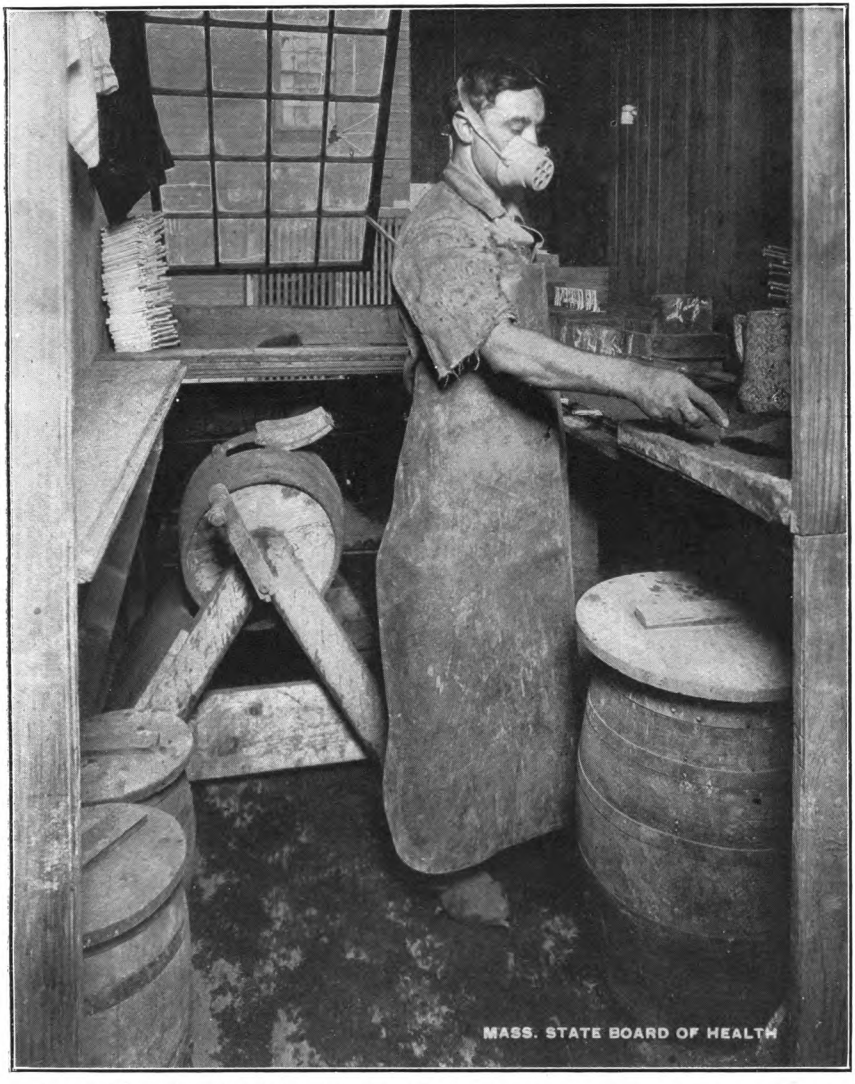

PLATE 48.—LEAD WORKING IN THE MANUFACTURE OF STORAGE BATTERIES.

In mixing red oxide of lead and litharge employees are exposed to lead poisoning. The employee shown was wearing a respirator, but was not willing to wear long gloves.

PLATE 49.—REMOVING LEAD FROM OVEN INTO METAL PAN.

The workman is unprotected against lead dust.

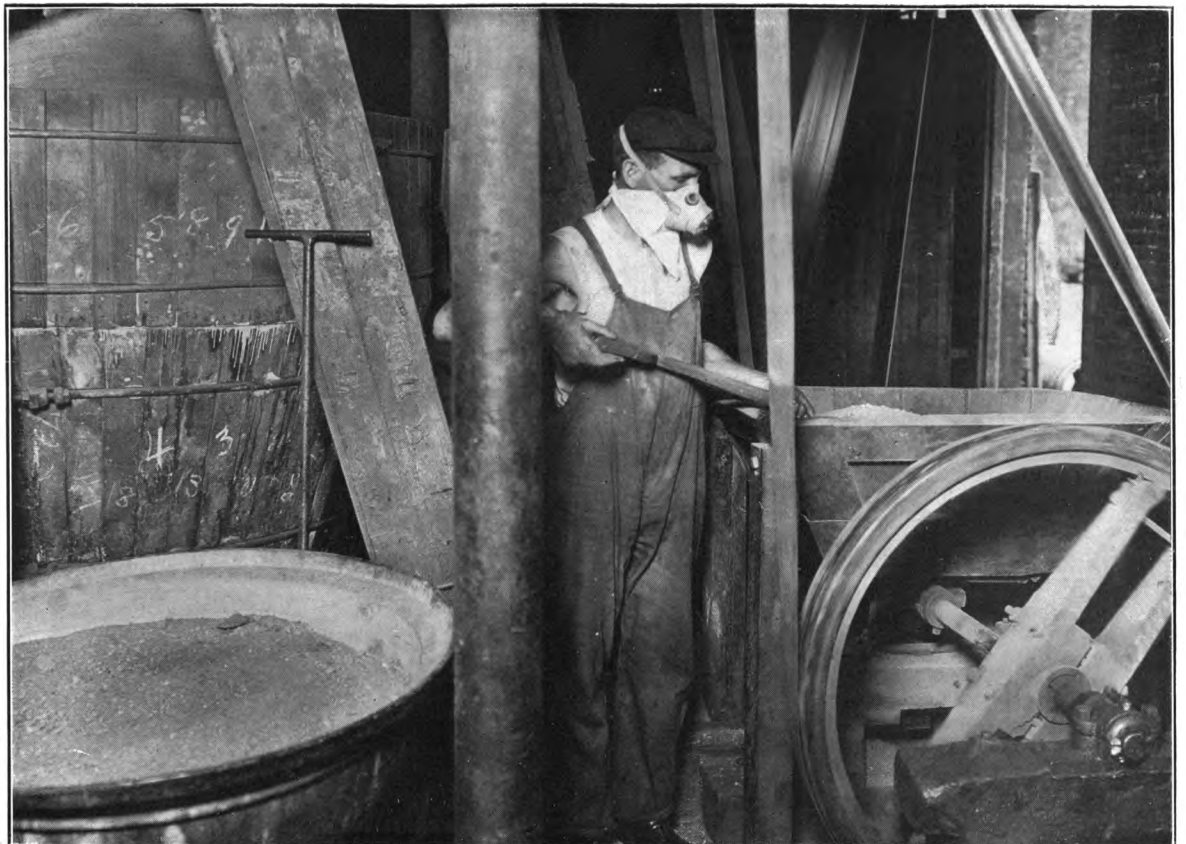

PLATE 50.—SHOVELING LEAD OXIDE INTO HOPPER.

This causes much fine dust. The workmen wear respirators.

PLATE 51.—ROOM IN BOOT AND SHOE FACTORY.

Women and girls are exposed to the fumes of naphtha from open bowls of cement.

PLATE 52.—ROOM IN BOOT AND SHOE FACTORY.

In order to protect employees from fumes naphtha cement is kept in specially constructed containers, the tops of which are open for short intervals only.

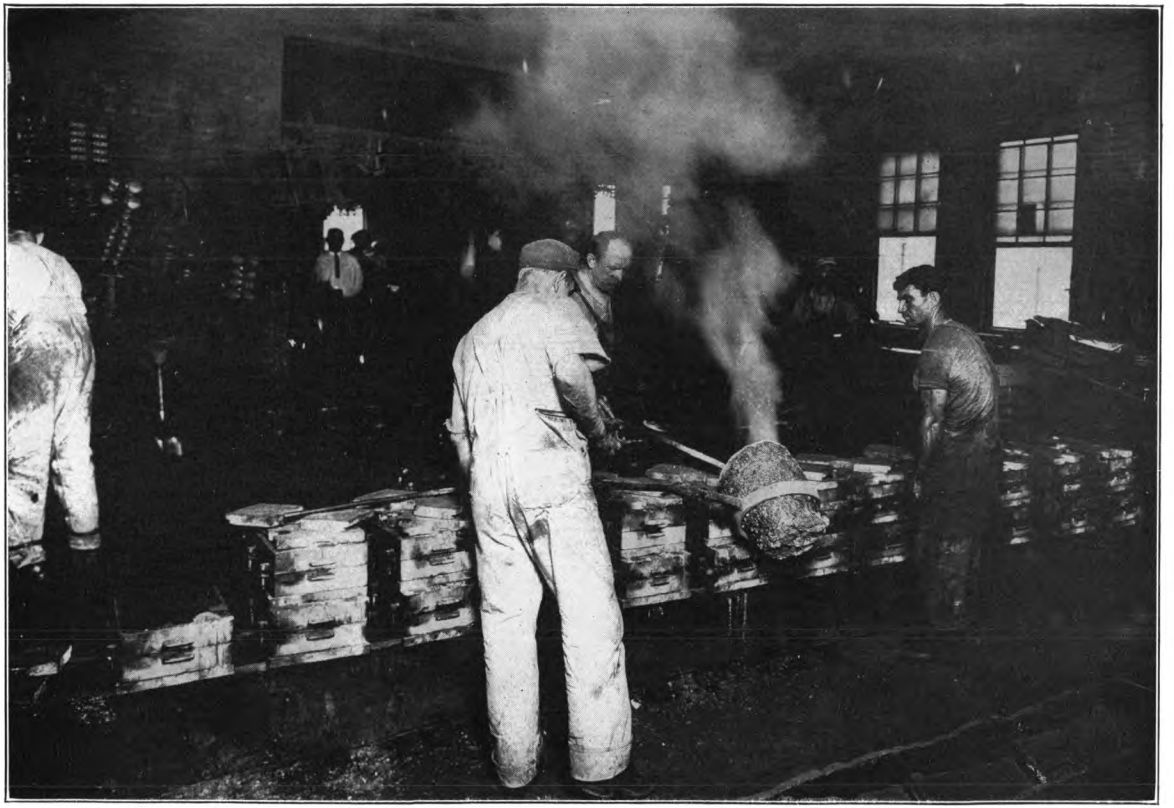

PLATE 53.—CASTING YELLOW BRASS.

When the molten metal is poured into the molds, fumes of zinc arise and are precipitated by the cool air of the room into fine gray powdered flakes. In the room shown these are unavoidably inhaled by the workmen, who are thus exposed to the disease known as brass founders' ague.

PLATE 54.—CASTING YELLOW BRASS.

Brass workers are here protected from zinc fumes by an adequate exhaust system.

PLATE 55.—MANUFACTURE OF DERBY AND FELT HATS.

The felt cone is treated with a solution of shellac and wood alcohol, and the workman is exposed to poisonous fumes of the alcohol. The method of removing the fumes shown in the illustration is not satisfactory.

PLATE 56.—BRUSH MAKING.

In the manufacture of brushes a cement of wood alcohol and shellac is used. The workmen shown are exposed to the fumes of wood alcohol, which are not satisfactorily removed.

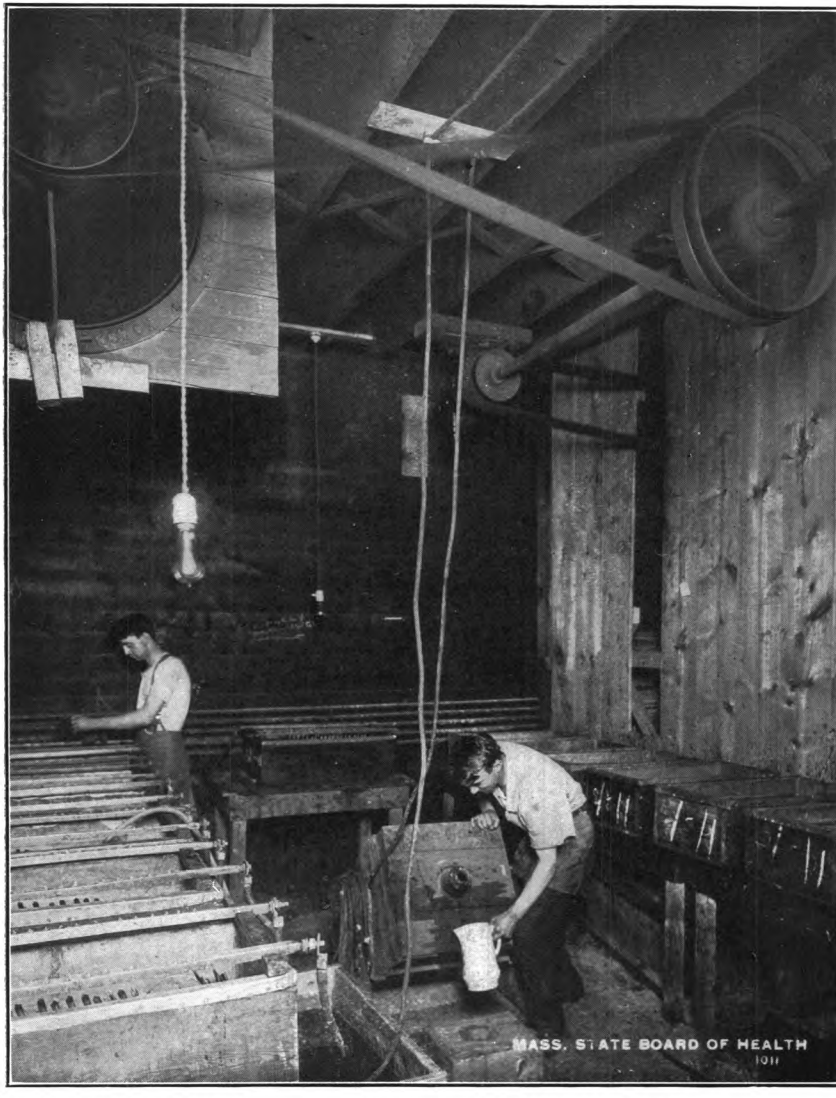

PLATE 57.—MANUFACTURE OF STORAGE BATTERIES.

In the process here shown workmen are exposed to hydrogen gas, though there is a large exhaust fan in the room.

PLATE 58.—JEWELRY INDUSTRY.

The workmen shown are exposed to dilute cyanide of potassium, which with gold forms the coloring solution used in treating the jewelry.

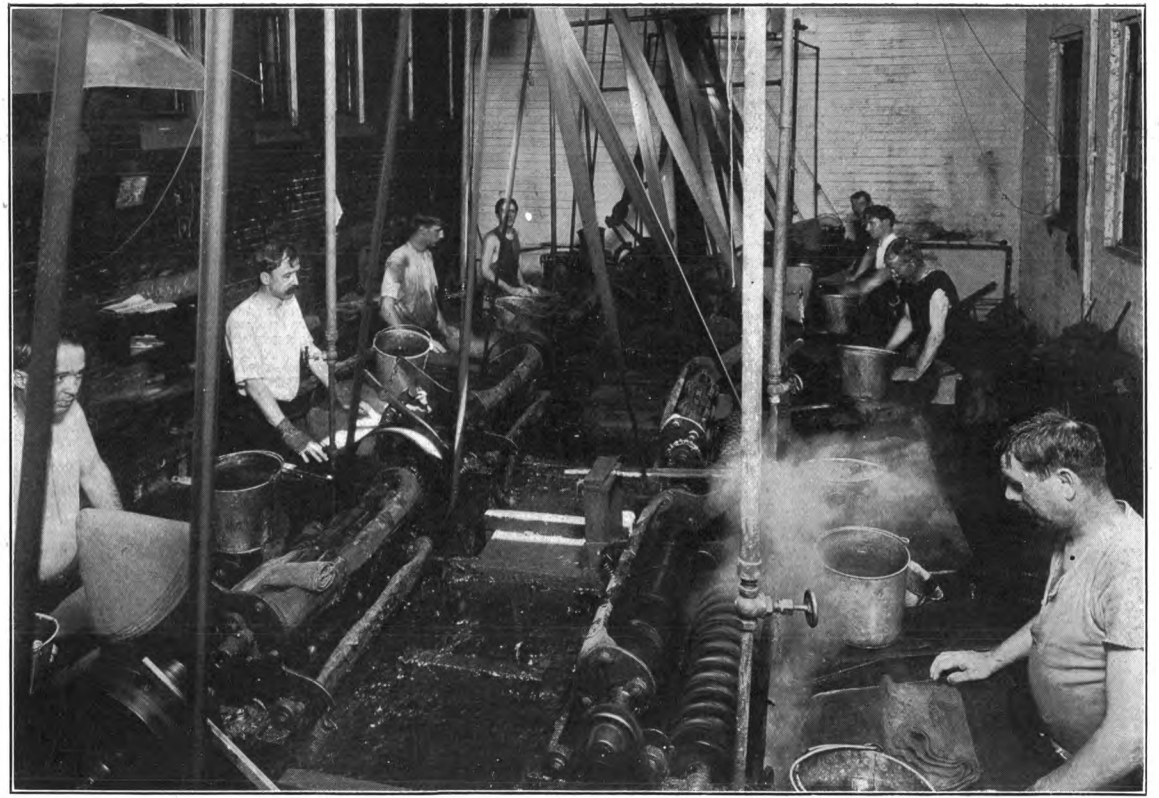

PLATE 59.—MANUFACTURE OF FELT HATS.

The copper cone, covered with a layer of fine hairs forming the felt, is plunged in hot water which causes the hairs to become more matted. The layer is then pulled from the cone and sent to the shrinking room. The workmen shown are exposed to excessive heat and humidity.

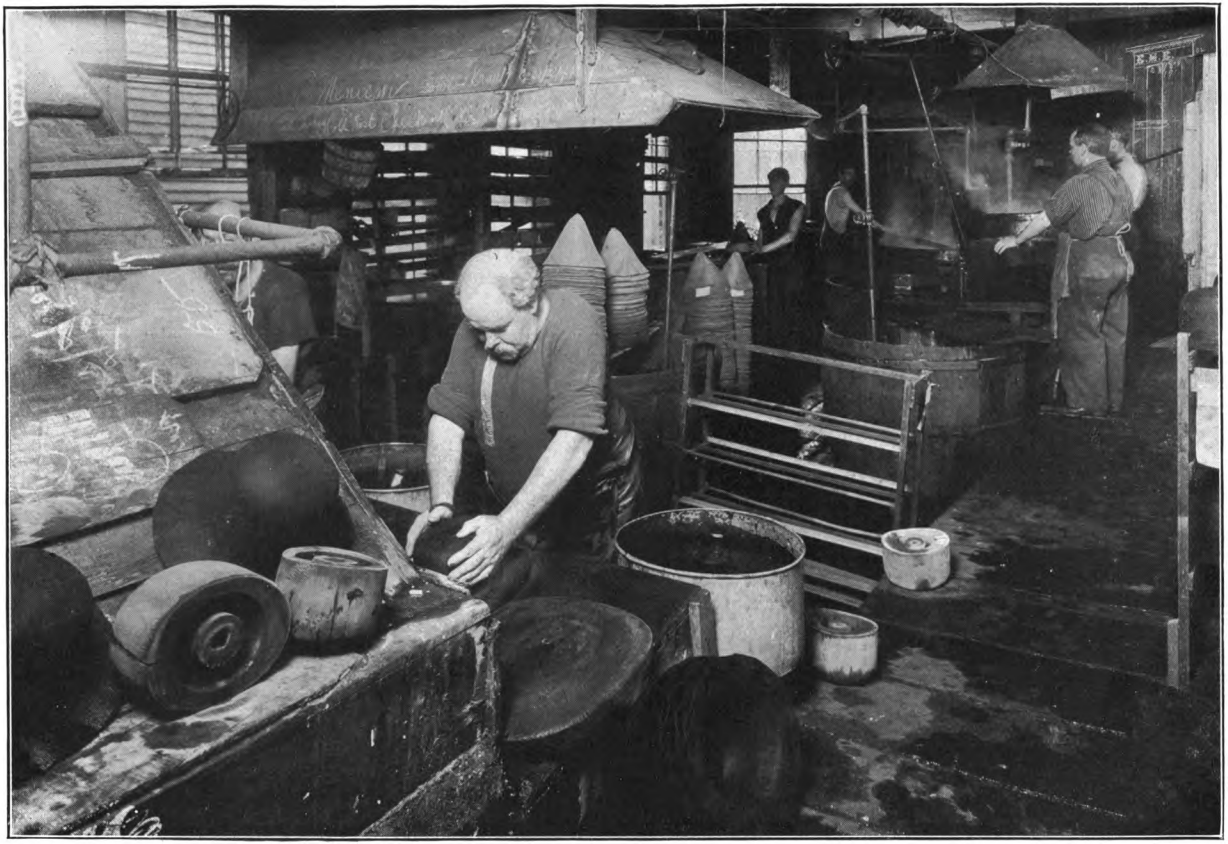

PLATE 60.—MANUFACTURE OF FELT HATS.

This illustration shows reasonable protection against excessive heat and humidity.

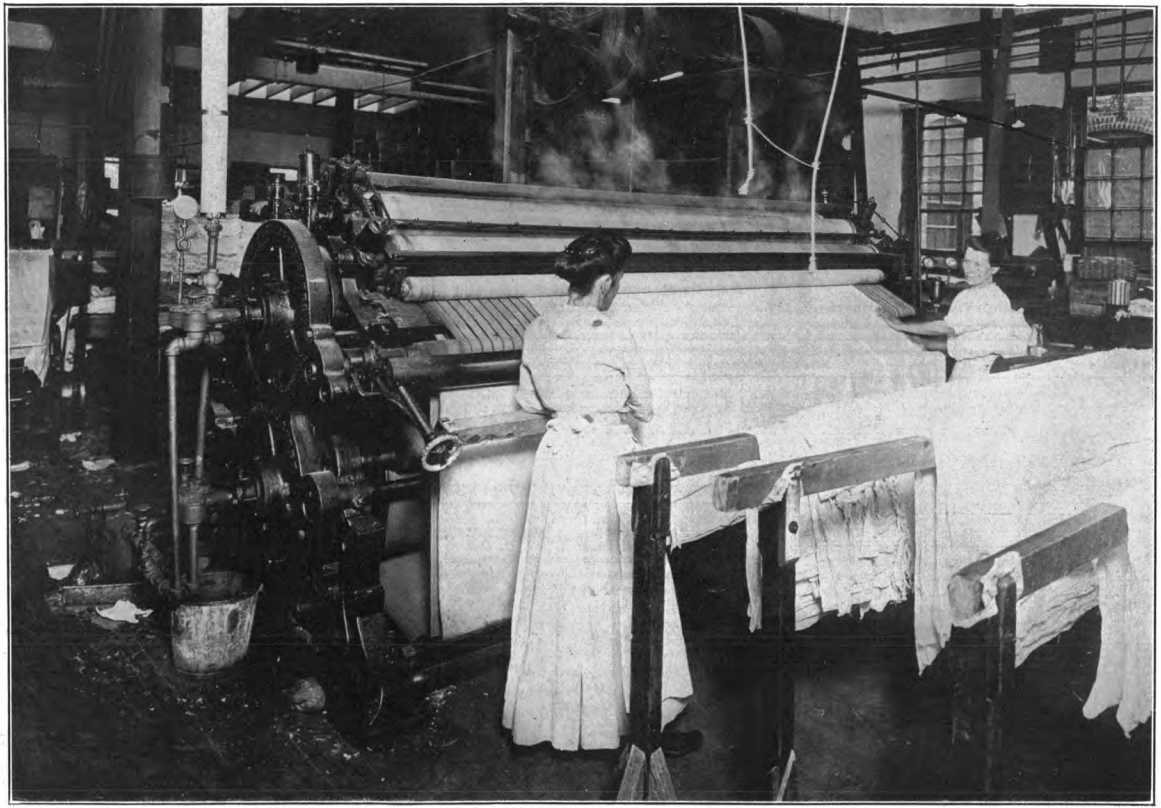

PLATE 61.—LAUNDRY WORKERS.

The flat-work ironing machine shown is not protected by an exhaust system and the steam disperses through the room, causing excessive heat and humidity.

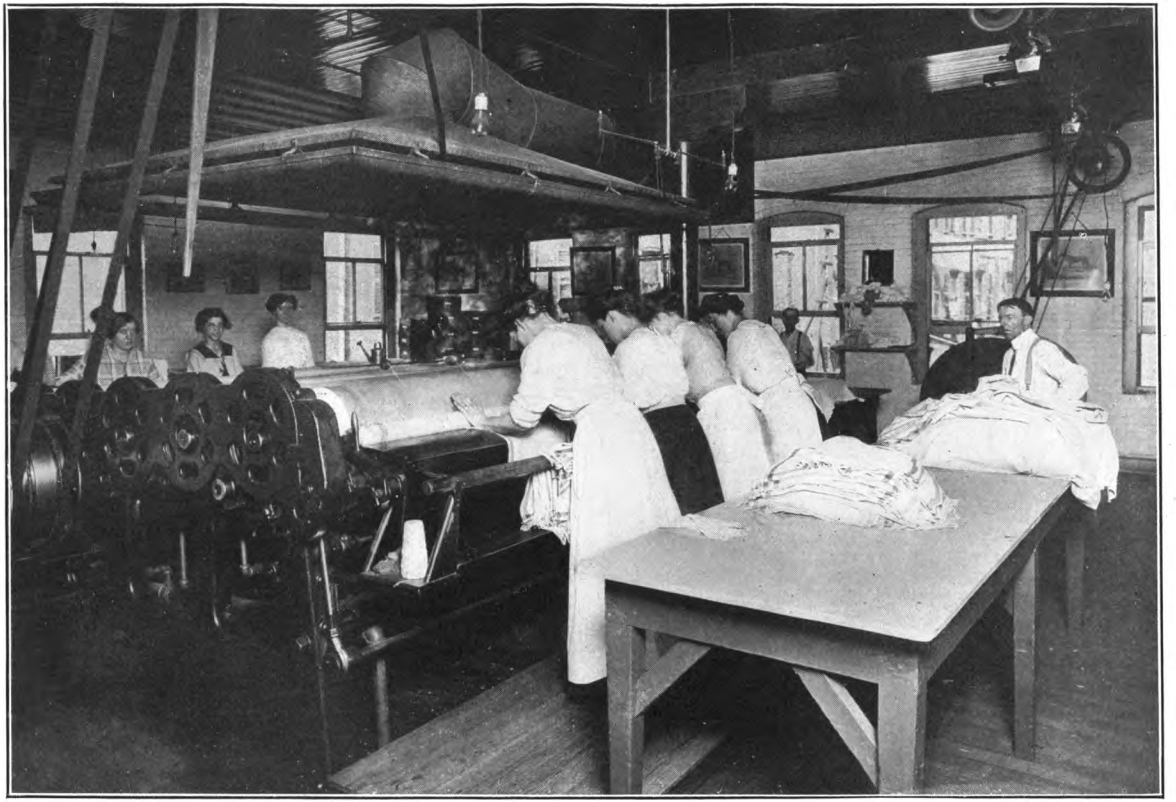

PLATE 62.—LAUNDRY WORKERS.

The flat-work ironing machine shown is provided with an excellent overhead hood connected by suction pipes with an exhaust fan.