Injuries and Accident Causes in the Manufacture of Pulp and Paper

A Detailed Analysis of Hazards and of Injury Rates for 1948 by Region, Plant Size, and Operating Departments

Bulletin No. 1036

UNITED STATES DEPARTMENT OF LABOR
MAURICE J. TOBIN, *Secretary*

BUREAU OF LABOR STATISTICS
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Letter of Transmittal

UNITED STATES DEPARTMENT OF LABOR,
BUREAU OF LABOR STATISTICS,
Washington, D. C., August 1, 1951.

The SECRETARY OF LABOR:

I have the honor to transmit herewith a report on the occurrence and causes of work injuries in the pulp and paper manufacturing industry.

This report, a portion of which appeared in the September 1950 Monthly Labor Review, constitutes a part of the Bureau's regular program of compiling work-injury information for use in accident-prevention work. The statistical analysis and the preparation of the report were performed in the Bureau's Branch of Industrial Hazards by Frank S. McElroy, George R. McCormack, and Luther E. Stone. The specific accident-prevention suggestions were prepared by Sheldon W. Homan of the Division of Safety Standards of the Bureau of Labor Standards.

EWAN CLAGUE, *Commissioner.*

Hon. MAURICE J. TOBIN,
Secretary of Labor.

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Abstract

Injury-frequency rates for pulp and paper manufacturing improved more rapidly than the all-manufacturing average in the 1944–49 period. In 1949 the frequency rate for pulp and paper, 16.4, was only 9 percent above the all-manufacturing rate of 15.0. This was a reduction of 44 percent from the 1944 rate of 29.2, which was 59 percent higher than the all-manufacturing average of 18.4 in that year.

Approximately 7,900 disabling injuries occurred in pulp and paper manufacturing during 1949. The economic loss, including direct and indirect costs, resulting from these injuries is estimated at about $25 million.

Paper-making plants generally had lower injury rates than those exclusively engaged in making pulp. The best group rate in 1948 was 11.8 for building-paper plants. For pulp plants the corresponding average was 26.7.

Comparisons among the production departments of the reporting plants indicate that injuries occur most frequently in the woodyards, which had an average frequency rate of 41.2. Woodrooms, paper-machine rooms, rag-shredding departments, groundwood mills, sulfite mills, and beater rooms all had rates of over 20. Sulfate mills, soda mills, wet rooms, bleaching departments, and converting departments had rates ranging between 10 and 20. Rag mills had the lowest production department rate, 6.8.

The records show a definite inverse relationship between the frequency-rate level and plant size with the first significant break occurring at about the 250-employee level. Up to the 250-employee level, plant size variations appear to have little bearing upon the occurrence of injuries.

An unusually high proportion of the plants in the pulp and paper industry maintain organized safety programs. Over 75 percent of the 534 plants surveyed reported having some form of safety program. There seemed to be a significant relationship between a plant's injury record and the presence of a safety engineer. The development of in-plant safety programs and the maintenance of medical or first-aid programs both seem to be closely related to plant-size variations.

About a fourth of all the recorded injuries resulted from contact with machines; flying particles produced 12 percent; hand tools, 9 percent; pulpwood logs, 7 percent; working surfaces, 6 percent; paper, 6 percent; and chemicals, 4 percent.

Over 37 percent of the recorded accidents were cases in which workers were struck by moving, falling, or flying objects. About 14 percent of the injuries resulted from workers bumping into or striking against fixed objects. Another 14 percent resulted from workers getting caught in or between objects. Falls were responsible for 10 percent of the injuries, overexertion for 9 percent, and slips or stumbles for 5 percent.

Slippery working surfaces, inadequately guarded machinery, exposure to hot or toxic materials, and improperly piled materials were the physical causes of many accidents. Manual handling of heavy materials and the absence of personal protective devices were also prominent accident causes.

Outstanding among the unsafe acts which resulted in accidents were: Misuse of hand tools, improper material handling, inattention to footing or surroundings, improper piling of materials, failure to warn others when starting machinery, and failure to wear goggles where required.

Accident-prevention suggestions, prepared by the Division of Safety Standards of the Bureau of Labor Standards, indicate that most accidents in the industry could be prevented through the application of very simple precautions.

Injuries and Accident Causes in the Manufacture of Pulp and Paper

The Industry Record

In 1949 the injury-frequency rate [1] for pulp and paper manufacturing dipped to its lowest level in many years. In that year the industry average of 16.4 disabling injuries [2] for every million employee-hours worked was only 9 percent higher than the all-manufacturing average of 15.0. This was in sharp contrast to the wide spread between the two rates in 1944 and previous years.

In 1939 the injury-frequency rate for pulp and paper manufacturing was 22.0, about 48 percent higher than the all-manufacturing rate of 14.9. During the next few years, wartime influences such as shortages of trained workers, new equipment, and repair parts, and pressure for increased production caused the injury-frequency rates for most manufacturing industries to rise. The pulp and paper rate, however, rose more than the average, and in 1944 reached 29.2. At this point it was 59 percent above the all-manufacturing average of 18.4. Since 1944, the pulp and paper rate has consistently improved, moving downward much more rapidly than did the all-manufacturing average. The 1949 rate of 16.4 for paper and pulp manufacturing represents a remarkable achievement—a reduction of 44 percent in work injuries during a period of only 5 years.

Despite this praiseworthy improvement, the pulp and paper industry was still faced with a substantial work-injury problem not fully evident in the injury rates. The abstract qualities of injury rates give injuries somewhat the status of bookkeeping entries and tend to obscure the human and economic factors constituting the fundamentals of the problem. The suffering, despair, and frustration of injured workers and their families cannot be measured. Nor can the full monetary cost of accidents be determined from any available records. It is possible, however, to approximate the economic loss arising from the injuries and thereby bring the problem into better perspective.

[1] The injury-frequency rate is the average number of disabling work injuries for each million employee-hours worked. See chapter on Scope and Method p. 3 for additional definitions.

[2] A disabling work injury is any injury occurring in the course of and arising out of employment, which (a) results in death or any degree of permanent physical impairment, or (b) makes the injured person unable to perform the duties of any regularly established job open and available to him, throughout the hours corresponding to his regular shift on any day after the day of injury, including Sundays, holidays, and periods of plant shut-down.

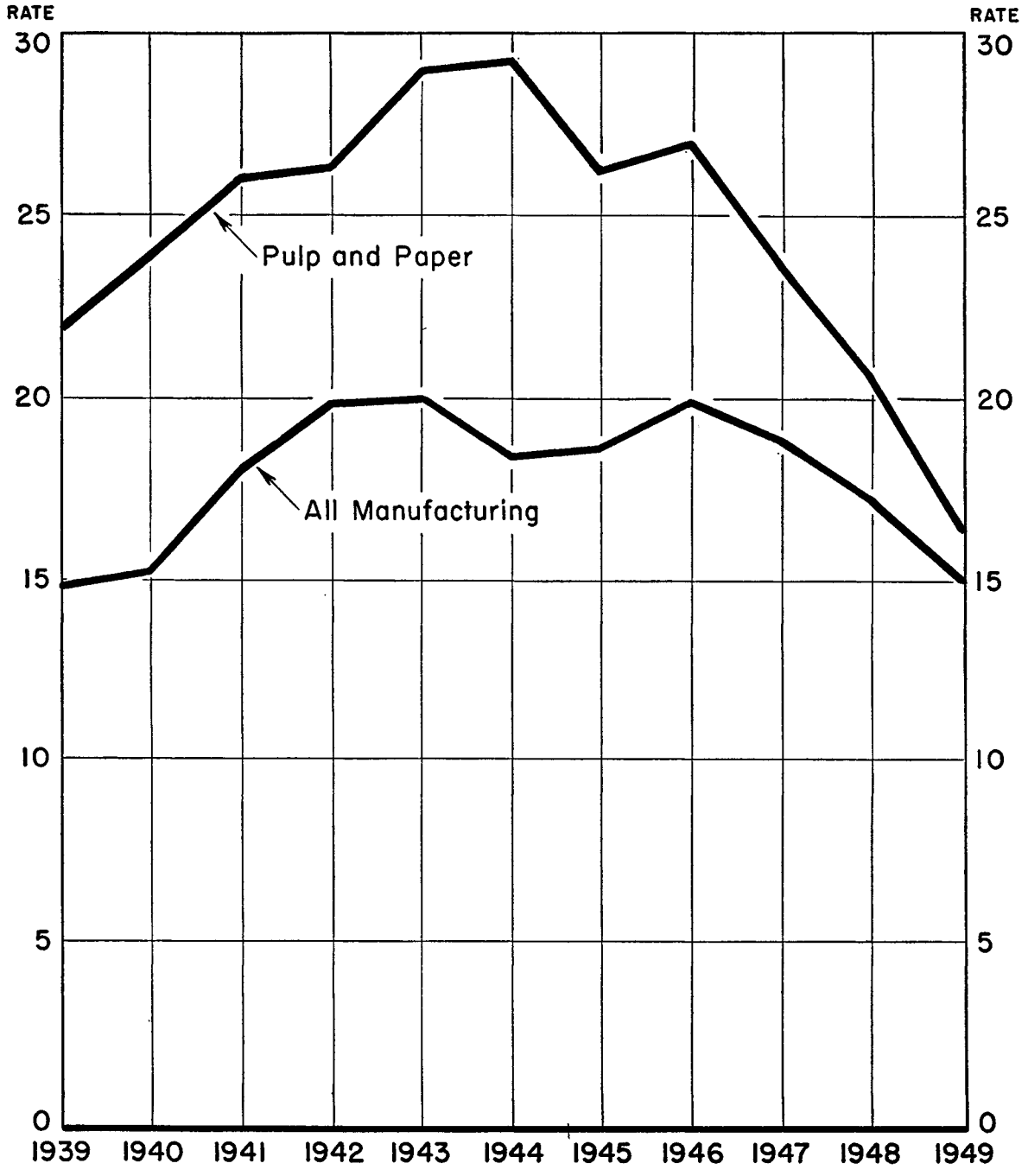
Estimate of Injury Costs

About 7,900 workers in the pulp and paper industry experienced disabling injuries in the course of employment during 1949. This represents 1 disabling injury for every 29 workers in the industry.

Approximately 40 of these injured workers died as a result of their injuries and 10 others were totally disabled for the remainder of their lives. In addition, about 600 experienced some lesser degree of permanent physical impairment. The remaining 7,250 workers suffered no permanent ill effects, but each was injured seriously enough to require at least one full day for recovery.

Although no accurate records of the costs of these injuries are available, it is apparent that they represent a tremendous economic loss which

CHART I. COMPARISON OF INJURY-FREQUENCY RATES PULP AND PAPER INDUSTRY AND ALL MANUFACTURING



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must be absorbed by the injured workers, their employers, and the consumers of the industry's products.

The actual time lost by the injured workers during 1949 is estimated at about 183,000 man-days. Time lost within the year, however, does not adequately measure the real work loss resulting from injuries. Many of the seriously injured workers will find their earning ability reduced for the remainder of their lives. The loss for fatally injured workers is equivalent to their total expected earnings for years in which they would have worked had their careers not been cut short. If additional allowance were made for the future effects of the deaths and permanent impairments included in the total, the economic time-loss chargeable to the injuries experienced in 1949 would amount to 825,000 man-days. Evaluated on the basis of 1949 average earnings for production workers in the industry ($59.83 a week),[3] this represents a loss of about $7 million in present and future earnings. In part, this loss is covered by workmen's compensation payments financed by the employers. Because compensation payments are never equivalent to full wages, however, a considerable portion of this loss must fall upon the injured workers and their dependents.

Wage losses, however, are only part of the total cost of accidents resulting in work injuries. In addition, there are payments for medical and hospital care and many indirect costs, such as damage to materials and equipment, interrupted production schedules, cost of training replacement workers, time lost by other workers stopping to offer assistance at the time of the accident, and supervisory time spent caring for the injured or reorganizing operations after the accident. Unfortunately, the indirect costs are seldom recorded, and, as a result, cannot be determined accurately. Studies have indicated, however, that the indirect costs of injury-producing accidents for all-manufacturing average about four times the direct costs of compensation payments, plus medical and hospital expenses.[4] Assuming that this ratio is approximately correct for the pulp and paper industry, the indirect cost of the injury-producing accidents in 1949 would amount to about $17 million, bringing the total costs including medical expenses to approximately $25 million.

[3] Monthly Labor Review, May 1950.

[4] Industrial Accident Prevention, by H. W. Heinrich, New York, McGraw-Hill Book Co., 1941.

Scope and Method of Survey

The United States Bureau of Labor Statistics has compiled annual injury rates for the pulp and paper manufacturing industry each year since 1926. In recent years these surveys have included reports from nearly 500 employers, representing a total exposure of over 400 million man-hours of employment. All of the data assembled in the annual surveys are collected by mail. Reporting is entirely voluntary.

In order to provide greater detail and to permit more specific analysis than is usually possible on the basis of the annual surveys, the survey was modified in 1948. The report form was enlarged and each cooperating employer was requested to report separately for each department or type of operation carried on in his plant. In addition, he was asked to describe his plant safety program and the first-aid facilities available to his employees. Usable reports were received from 534 plants, employing approximately 207,000 workers, with a total exposure of over 454 million man-hours. The reporting group included 14 plants which manufacture pulp only, 281 which manufacture one or more varieties of paper, 152 which manufacture paperboard, and 87 which did not identify their principal products sufficiently to permit exact classification on this basis.

In addition to supplying summary reports for use in evaluating the magnitude and general aspects of the injury problem in the industry, 106 of the cooperating plants also made their original accident records available for detailed analysis. This group of plants, employing about 80,000 workers, had a combined injury-frequency rate of 20.6. Although this was about 4 percent above the industry average, there was no indication that their hazards differed greatly from those of other plants in the industry.

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A representative of the Bureau visited each of the 106 cooperating plants, and insofar as the data were available, transcribed from their records the following items regarding each accident: (*a*) Place of accident; (*b*) occupation, age, and sex of injured worker; (*c*) nature of injury and part of body injured; (*d*) object or substance producing injury; (*e*) type of accident; (*f*) unsafe condition and/or unsafe act leading to accident; and (*g*) object or substance associated with the unsafe condition. In order to broaden the analysis and permit a greater degree of detail, this part of the survey was extended in some plants to cover not only disabling injuries, but also to include all injuries requiring treatment by physicians. Some 3,286 disabling injury cases and 2,960 medical cases were recorded.

Injury Rates

The injury-rate comparisons presented in this report are based primarily upon injury-frequency and severity rates compiled under the definitions and procedures specified in the American Standard Method of Compiling Industrial Injury Rates, as approved by the American Standards Association in 1945. These standard rates have been supplemented by an additional measure of injury severity designated as the average time charge per disabling injury.

Injury-Frequency Rates.—The injury-frequency rate represents the average number of disabling work injuries occurring in each million employee-hours worked. It is computed according to the following formula:

$$\text{Frequency rate} = \frac{\text{Number of disabling injuries} \times 1{,}000{,}000}{\text{Number of employee-hours worked}}$$

Average Time Charge Per Injury.—The relative severity of a temporary injury is measured by the number of calendar days during which the injured person is unable to work at any regularly established job open and available to him, excluding the day of injury and the day on which he returns to work. The relative severity of death and permanent impairment cases is determined by reference to a table of economic time charges included in the American Standard Method of Compiling Industrial Injury Rates. These time charges, based upon an average working-life expectancy of 20 years for the entire working population, represent the average percentage of working ability lost as the result of specified impairments, expressed in unproductive days. The average time charge per disabling injury is computed by adding the days lost for each temporary injury and the days charged according to the standard table for each death and permanent impairment and dividing the total by the number of disabling injuries.

Injury-Severity Rate.—The injury-severity rate weights each disabling injury with its corresponding time loss or time charge and expresses the aggregate in terms of the average number of days lost or charged per 1,000 employee-hours worked. It is computed according to the following formula:

$$\text{Severity rate} = \frac{\text{Total days lost or charged} \times 1{,}000}{\text{Number of employee-hours worked}}$$

Accident-Cause Analysis

The accident-cause analysis procedure used in this study differs in some respects from the procedures specified in the American Standard Method of Compiling Industrial Accident Causes and usually followed in the Bureau's studies. The deviations from the Standard include the introduction of an additional analysis factor, termed the "agency of injury" and the modification of the standard definitions of some of the other factors. These changes permit more accurate cross classifications.

Agency of Injury.—The standard classification provides for the selection of but one "agency" in the analysis of each accident. By definition, this agency may be either (a) the object or substance which was unsafe and thereby contributed to the occurrence of the accident, or (b) in the absence of such an unsafe object or substance, the object or substance most closely related to the injury. Under this definition, therefore, a tabulation of "agencies" for a group of accidents includes objects or substances which may have been inherently safe and unrelated to the occurrence of the accidents as well as those which led to the occurrence of accidents because of their condition,

location, structure, or method of use. The development of the classification "agency of injury" represents an attempt to separate and classify separately these two agency concepts.

As used in this study, the "agency of injury" is the object, substance, or bodily reaction which actually produced the injury, selected without regard to its safety characteristics or its influence upon the chain of events constituting the accident.

Accident Type.—As used in this study, the accident type classification assigned to each accident is purely descriptive of the occurrence resulting in an injury and is related specifically to the agency of injury. It indicates how the injured person came into contact with or was affected by the previously selected agency of injury. This represents a change from the standard procedure in two respects: First, the accident type classification is specifically related to the previously selected agency of injury, and second, the sequence of selecting this factor is specified.

Unsafe Condition.—Under the standard definition, the unsafe condition indicated in the analysis is defined as the "unsafe mechanical or physical condition of the selected agency which could have been guarded or corrected." This implies the prior selection of the "agency" but does not provide for recognition of any relationship between the unsafe condition and accident type classifications. Nor does the standard provide for any definite relationship between the "agency" and the "accident type" classifications.

To provide continuity and to establish direct relationships among the various analysis factors to permit cross classification, the standard definition was modified for this study to read: "The unsafe mechanical or physical condition is the hazardous condition which permitted or occasioned the occurrence of the selected accident type." The unsafe condition classification, therefore, was selected after the determination of the accident type classification. It represents the physical or mechanical reason for the occurrence of that particular accident without regard to the feasibility of guarding or correcting the unsafe condition.

Elimination of the condition "which could have been guarded or corrected" is based upon the premise that statistical analysis should indicate the existence of hazards, but should not attempt to specify the feasibility of corrective measures.

Agency of Accident.—For the purpose of this study, the agency of accident was defined as "the object, substance, or premises in or about which the unsafe condition existed." Its selection, therefore, is directly associated with the unsafe condition leading to the occurrence of the accident and not with the occurrence of the injury. In many instances the agency of injury and the agency of accident were identical. The double agency classification, however, avoids any possibility of ambiguity in the interpretation of the "agency" tabulations.

Unsafe Act.—The unsafe act definition used in this survey is identical with the standard definition, i. e., "that violation of a commonly accepted safe procedure which resulted in the selected accident type."

The Industry and Its Hazards

The pulp and paper industry, as defined for this survey, includes all plants manufacturing either pulp or paper, or both. Many of these plants also process their paper into various specialties, engaging in what are commonly termed finishing and converting operations. Where these finishing and converting operations are performed upon paper manufactured in the same plant, the plant has been considered as being in the pulp and paper industry. Plants engaged exclusively in finishing or converting paper manufactured in other establishments have been excluded from the survey.

Many of the pulp and paper plants own timber lands and cut their own pulpwood as an integrated part of their operations. However, because the hazards of pulpwood logging were covered in a previous study [5] these operations have been ex-

[5] Injuries and Accident Causes in the Pulpwood Logging Industry, 1943 and 1944, Bureau of Labor Statistics Bulletin No. 924.

cluded from this survey. The sequence of operations covered in this survey, therefore, begins with the arrival of the pulpwood at the plant woodyards.

The Woodyard

Although practices vary among plants, most of the mills in the East, South, and Central regions receive their pulpwood in precut standard lengths. In the Northeast it is customary to field cut the logs into lengths of about 50 inches. In the South the standard length is about 63 inches, whereas operators in the Great Lakes areas cut to a length of about 100 inches. In general the pulpwood sticks in these regions are of relatively small diameter. The West Coast mills, on the other hand, commonly receive logs of full saw-timber size, approximating 40 feet in length and ranging up to 4 feet in diameter.

Logs reach the mills in a variety of ways. Much of the wood is floated to the mills on rivers, lakes, or sluices in the North and West Coast areas. On the rivers and lakes, the common practice is to assemble the logs into rafts which are then towed to the mills. Barges are also used to transport the sticks in many instances. Many mills receive some or all of their wood by rail or truck. Truck deliveries are by far the most common in the South.

Logs reaching the mill by water are usually floated into a mill pond where boom men direct them to a chain conveyor called a log haul, which carries them directly to the slasher saws or barker. Wood arriving by rail or by truck may be unloaded by hand or by means of a crane-type mechanism called a jammer. In manual operations the pulpwood sticks are usually transferred directly onto a conveyor leading to a storage pile or to the wood room for processing. With the jammer, the wood may be lifted directly from the car or truck to the pile or it may be dropped onto the conveyor. Jammers are also used to transfer logs from the storage piles to the conveyors leading into the wood rooms of the mills.

Workers in the woodyards face a wide variety of hazards. Even in the highly mechanized yards a great deal of strenuous manual work is necessary. The logs are usually quite heavy and awkward to handle. Strains and sprains from overlifting are, therefore, very common. Insecure footing also leads to many injuries. Wet and slippery surfaces around the ponds present the possibility of slips or falls into the water. In the yard proper the ground is frequently slippery with moisture or ice and is often rough and irregular because of the heavy traffic.

In removing wood from cars or trucks there is always the possibility of being struck by a dropped log or that logs may roll from the vehicles onto workers on the ground. Generally, someone must work on top of the load, where he faces the possibility of falling on the irregular surfaces of the logs and the more serious hazard of having loose logs roll and carry him to the ground.

Pulphooks and pickaroons are commonly used to handle the logs in manual operations. These tools have sharp points to pierce the wood, but usually a great deal of force is required to drive them home. When the points are dull or the log is not struck at the proper angle these tools may glance off and strike the user or a nearby co-worker. When not properly imbedded in the wood, they may pull out and throw the worker off balance or cause him to lose control of the log, which may then fall or roll against him or some other worker.

Mechanical handling speeds the work and eliminates some of the hazards of manual operations. It does, however, introduce other and sometimes more serious hazards. When jammers or other types of hoisting equipment are used to lift the logs, workers on the ground are exposed to the danger of being struck by sticks falling from unbalanced loads. There is also the possibility of being struck by a swinging load which may crush the unwary worker, if he happens to be caught between it and a fixed object. In addition, there is the danger that the logs may roll or slide when released on the stack. Other mechanical hazards include the possibility of becoming caught in the conveyors and of being struck by the log trucks as they maneuver about the yard.

The Wood Room

The wood is usually carried by conveyor or sluice from the woodyard to the wood room, where it is reduced and prepared for pulping. In the mills of the Eastern and Central regions the

logs are sorted by size. The smaller logs are passed directly to the barking drums, but the larger ones go first to a slasher saw.

The slasher may be either a swing saw or a stationary saw. In a swing saw operation the circular saw blade is suspended at the end of an arm or bar which swings in a vertical arc from an overhead pivot. When not actually cutting, the saw blade is swung away from the cutting position and held by balance weights and chains. The log-haul conveyor moves the log in front of the saw and is stopped when it is in the proper position. The saw is then swung down to cut the log to the desired length. When the saw has been swung back, the conveyor carries the cut pieces on to the next operation.

A stationary slasher may consist of one or several circular saw blades mounted in a saw table at the side of the conveyor. A section of this table slides horizontally from the conveyor to the saw. The logs are pushed from the conveyor onto this slide, which carries them against the saw or saws and returns the cut pieces to the conveyor.

A typical barking drum consists of a rotating cylinder about 40 feet long and 10 feet in diameter. The cylinder is a framework of longitudinal steel slats with openings of about 3 inches between the slats. This drum is mounted on a slight angle off the horizontal. The conveyor dumps the sticks into the high end of the revolving drum where they are tumbled and rubbed against each other and against the steel slats as they work their way to the lower end. This grinding and rubbing knocks off most of the bark which falls through the openings between the slats. In some instances water is sprayed into the drum to help loosen the bark and wash it through the openings between the slats.

From the barking drum the sticks again pass onto a conveyor. Here they are inspected and those requiring further barking are removed and returned to the barker. If fine paper is being made, all sticks containing knots or defects are directed to the knotters. Several types of knotters are in common use. A popular type consists of a slotted disc holding four radial knives. As the disc revolves at high speed, the knotter man pushes the stick against the knives which plane off the knot or defective portion. This equipment may also be used to remove small sections of bark which may still be adhering to the wood. Another type of knotter in common use is a boring device. In this process the stick is placed under the boring tool which drills out the knotty portion.

Sticks of large diameter must go to the splitter. This consists essentially of a heavy butt plate that holds one end of the log and a steam-powered shaft that drives a wedge-shaped tool against the other end. Using a single wedge, the smaller logs are split into two longitudinal sections. Larger logs are split into quarter sections by using a double wedge. As the log reaches the splitter, the splitterman stops the conveyor and, using two hooks, places the log against the butt plate and releases the steam which forces the shaft against the other end.

In the West-Coast mills the wood room operations are performed on a more massive scale, similar to sawmill operations. Usually, the 40-foot logs are carried by conveyor first to a huge swing saw. Here the logs are cut into two 20-foot lengths which then pass on to a hydraulic barker. This operation is completely enclosed and is controlled by a barkerman from an adjoining room where he watches the process through five-ply laminated glass. The log is held by its two ends and rotated similarly to a piece of stock in the chuck of a lathe. An arm carrying a nozzle moves lengthwise over the log and directs a high pressure stream of water against it. This water jet knocks the bark off.

From the hydraulic barker the logs go by conveyor to the head rig bandsaw, where they are placed upon a moving carriage. This carriage carries them repeatedly against a large bandsaw, which cuts them into long slabs about 8 inches in thickness. A transfer carriage carries these slabs, called cants, to a pair of parallel saws set about 8 inches apart, which reduce the slabs to pieces of about 8 by 8 inches. Decayed sections are cut out and removed for use as fuel. Unbarked cants from logs which bypassed the hydraulic barker are also pulled out at this point and are routed to the mechanical barker. Here they are placed, bark side up, on a carriage which carries them under a set of revolving knives. These shave off the bark. They are then returned to the conveyor, which carries them to the chipper or grinder, depending upon the type of paper to be made. Chipping prepares the wood for the first of the chemical pulping operations. This is usually a wood room activity. Grinding, on the other hand, is actually

the first step of the mechanical pulping process rather than a preparatory operation.

The chipper usually consists of a very heavy rotating disc carrying four radial knives. The disc rotates in a vertical position, but the pulpwood sticks or cants are fed to it through a chute set at a 45 degree angle. A conveyor carries the wood to the chute where it slides by gravity against the rotating disc. The revolving knives slice off chips, roughly three-eighths of an inch thick and three-fourths of an inch in length, diagonal to the grain of the wood.

From the chipper a conveyor or chute carries the chips to a three-layer vibrating screen. Here the oversized chips and all dirt, dust, and undersized chips are screened out. The chips of proper size are carried by a chip belt from the screen to the chip bins above the digesters. These bins are enormous cylinders, each holding several charges of chips for its digester.

Many of the hazards prevailing in the woodyard are also common to the wood room. Strains and sprains result from the handling of pulpwood. Sticks often fall from poorly imbedded pulp hooks or from conveyors, resulting in bruises and fractures. The use of pulp hooks results in many puncture wounds. Power equipment in the wood room also presents many hazards. Shearing injuries may result from getting caught in chains, sprockets, belts or pulleys of conveyors, barking drums or saws. There is danger of being struck by chips or slivers of wood thrown from the hand barkers or chippers. The operation of hand barkers and knotters is particularly hazardous, as it is very easy to permit the fingers to slip into the knives. In the splitting operation there is the possibility of crushed hands or fingers from getting them caught between the log and the butt plate or the log and splitter head. Pieces of wood may fly from the splitter and strike the splitterman. Saws are a source of lacerations or amputations. In many wood rooms it is necessary to walk on the wood transfers or conveyors. This hazardous footing leads to falls. It is often necessary to enter the hydraulic barker enclosure to remove logs which become fouled. Here the surface is of metal and is always wet and very slippery.

Mechanical Pulping

Wood pulping consists of reducing the logs to a wet fibrous mass. This is accomplished by one of five processes. One is a mechanical process in which the wood is ground into pulp. Three are chemical processes (an acid process producing sulfite pulp and two alkaline processes producing soda and sulfate pulp). The fifth process is semichemical.

In the mechanical process wood arrives at the grinders in 2- or 4-foot lengths and 1 foot or less in diameter. Three types of grinders are in general use: the pocket, the magazine, and the continuous type. Regardless of type, however, the principle is the same. Each reduces the wood to a fibrous pulp by pressing it against a revolving grindstone. The stone used is from 4 to 6 feet in diameter and wide enough to accommodate a 2- or 4-foot length of wood. Formerly natural stones were used, but recently specially designed carborundum stones have been developed which are rapidly replacing the natural stones.

The most widely used type is the pocket grinder. It is essentially a carborundum stone, or a series of carborundum stones, set on a large electrically- or water-powered steel shaft. Each stone is enclosed in a steel casing with three or four pockets, from which the equipment derives its name. The grinder man takes the wood from the conveyor or sluice and places it in the pockets or magazines by hand. When the pockets are full, he closes the door and hydraulic pressure pistons are released to press the logs against the stone. A constant stream of water is sprayed on the stone to keep down the heat generated by the friction and wash the pulp to the troughs below. Unlike chemical pulp, groundwood pulp contains all the wood materials, lignin and other associated constituents, as well as the cellulose fibers. This mixture results in a greater yield, but a weaker pulp. It is especially suitable for newsprint, when combined with sulfite pulp. It is used also to produce fine coated papers for books and magazines, when mixed with a small proportion of high-grade sulfite pulp.

Wood handling is the source of many injuries in the grinding room. Lifting heavy logs results

in sprains and strains. Logs falling from conveyors or dropping from hands or pulp hooks are responsible for bruises and fractures. Picaroons glancing off or slipping out of logs result in numerous puncture wounds. In feeding wood into the pockets of the grinders, fingers may be mashed between the wood and the pocket. The floors about the grinders are often wet and littered with ground wood, constituting a slipping hazard. Hot pulp and water sometimes splash from the grinders, and result in burns.

Sulfite Process

Chemical processing of wood chips into pulp consists primarily of cooking the chips under pressure in a chemical solution which dissolves or separates the lignin and other constituents of the wood from its cellulose fibers. In the sulfite process, primarily used on long-fibered nonresinous woods, the cooking liquor is a solution of calcium bisulfite. In most mills the production of this liquor from the raw materials, consisting principally of sulfur, limestone, and water, is carried on as an integral part of the pulping process.

Sulfur is fired by hand or through a hopper into a small furnace, where it is burned in a carefully controlled atmosphere. Sulfur dioxide gas, given off by the burning sulfur, is piped off through the back of the furnace, cooled by passing through pipes submerged in water, and then forced into an absorption tower. These are tall towers, constructed of concrete and lined with acid-resisting tile. Here the gas is absorbed into water, producing sulfuric acid, which in turn reacts with lime from calcium limestone to make the calcium bisulfite solution.

The digester, the vessel in which the chips are cooked, is a huge upright cylinder with conical ends. Digesters are constructed of 1¼-inch boiler plate and are lined with acid-resistant brick. They vary in size, ranging from about 9 to 19 feet in diameter and 45 to 58 feet in height, producing about 8 to 25 tons of pulp each filling.

A movable chute is used to feed the chips from the overhead chip bin to the digester. When the digester has been filled, the preheated cooking agent is pumped in and a heavy lid 18 to 24 inches in diameter is firmly bolted in place. All valves are closed to prevent leakage and the cooking process is started. The chips are cooked by indirect heat. The cooking liquor is pumped from the bottom of the digester; forced through the heating unit; returned to the top where it begins its downward circulation through the chips, and is again pumped from the bottom. At the same time steam is admitted at the bottom to create the necessary pressure. This drawing off, reheating, and recirculating cycle is continuous throughout the cooking process which normally takes from 8 to 16 hours, depending upon the kind and the moisture content of the wood and the desired character of the pulp. In this process practically all of the lignin, sugars, resin, mineral salts, and other constituents of the wood, except the pure cellulose fibers, are dissolved into the cooking liquor.

When the "cook" is finished the steam pressure is reduced, the valve on the blowpipe is opened, and the pressure in the digester blows the pulp through the blowpipe into the blow pit, a huge tank holding about twice as much pulp as its digester. The blow pit is lined with acid-resistant tile and has a perforated false bottom. The perforations permit the water with which the pulp is washed and the cooking liquor to pass, but are too small to admit the pulp. The water and cooking liquor pass through an outlet in the bottom of the blow pit to the sewer. A large hose is then used to thin the washed pulp to a consistency that can be pumped. The thinned pulp is then pumped to the storage tanks which supply the screens.

The chief hazards of the sulfite mill are those associated with high temperatures, chemicals, and material-handling operations. In the sulfur-burning process harmful fumes may be encountered, and contact with the furnace or with the pipes carrying hot gas may produce severe burns. The possibility of a dust explosion is also present in the sulfur house. Manual lifting and wheeling heavy limestone may produce strains or sprains and rolling or sliding limestone may produce hand and foot injuries. Work around the acid tower or the digester involves the possibility of contact with acids or acid fumes which can produce severe chemical burns. Workers at the digester may be burned by steam leaking from the steam lines or by contact with the hot stock, particularly when unplugging stopped-up lines. Cappers may be injured in handling the heavy digester caps and workers at the blow pit

face the possibility of falling into the pit. This possibility is increased by the fact that the floor around the blow pit is usually wet and slippery. High atmospheric temperatures present the possibility of heat exhaustion and strains and sprains frequently result from handling the large hoses used in thinning the pulp.

Sulfate and Soda Processes

The sulfate process is used primarily in reducing long-fibered wood to pulp. The cooking liquor is a mixture of caustic soda and sodium sulfide which is obtained by reducing sodium sulfate, the chemical from which the process derives its name. The digester and the cooking method for sulfate pulp is similar to that for sulfite pulp except that the digester is unlined and the time for cooking is less. Pulp produced by this process has the longest fibers and makes paper of great strength. The pulp and unbleached paper made by this process is commonly known as "kraft."

Washing sulfate pulp differs considerably from the sulfite process. The pulp is blown from the digester to the wash pan, where an agitator stirs the pulp as it is washed and thinned with waste liquor. In each succeeding wash, weaker liquor is used. As little water as possible is used, since all the water in the waste liquor has to be evaporated in the recovery process. It takes about 6 hours to wash and drain the pulp in a wash pan. The pulp is also washed in diffusers. Here the method differs somewhat, but the principle is the same.

As a matter of economy, it is necessary to recover as much of the cooking liquor as possible. The weak black liquor which is separated from the pulp in the wash pan is pumped to the evaporators in the soda recovery plant where the excess water is removed.

When the liquor leaves the last stage of evaporation it is a thick, gummy liquid. This is pumped into a rotary furnace where it is burned to a black ash composed of carbon and soda. The soda is leached from the ash in a quenching trough, causticized, and used in making fresh white liquor.

The soda process is used primarily for the reduction of the short-fibered deciduous woods. The chemical used in this process is sodium hydroxide (caustic soda). The chips are cooked 6 to 8 hours under about 110 pounds of steam pressure. When the pulp is properly cooked, it is blown from the digester to the wash pan, where it is washed in about the same manner as sulfate pulp.

Many of the hazards common in the sulfite mill are also found in the sulfate and soda mills. Caustic soda is the primary ingredient in the cooking liquor in the soda and sulfate processes and the possibility of serious chemical burns is the principal hazard in these departments. The recovery process is particularly hazardous. Severe temperature burns may result from bumping into the evaporators and pipes. Contact with live steam or steam lines may result in scalds or burns. There is the possibility of explosions in the evaporators or rotary furnaces. Burns from hot, black ash are not uncommon. In smelting, chunks of smelt often fall on the employee or strike his smelting rod thereby causing injury. Strains and sprains can result from handling and wheeling lime and soda ash. In the digester room the same hazards exist as in the sulfite digester room. There is, however, more danger of chemical burns because of the caustic nature of the cooking liquor. In the wash pan room hazards are similar to those in the blow pit room, except for the added hazard of exposure to caustic burns.

Semichemical Process

The semichemical process is more recently developed and not extensively used. In this process the chips are undercooked by one of the chemical processes and the remainder of the reduction is accomplished by mechanical treatment. The process combines the advantages of both the mechanical and chemical processes—greater yield than chemical pulp and greater strength than mechanical pulp.

The hazards in this process are primarily those of the particular chemical process used.

Pulp Screening and Washing

Pulp leaving the grinders in the mechanical pulp mills, the blow pit in the sulfite mills, or the wash pans or diffusers in the sulfate and soda mills, next passes through a series of screening and washing processes to remove any slivers, knots, dirt, or other undesired matter. Larger pieces of foreign matter are extracted as it flows through a fixed screen or through perforations in a revolving cylinder. Smaller, heavier particles of sand and

dirt settle out of the pulp as it flows slowly through the rifflers. These are long, shallow wooden troughs, sometimes lined with felt, with low partitions or baffles spaced about a foot apart to catch the heavier materials. For the final screening the pulp flows onto a brass plate which is pierced by a number of exceedingly fine slots. A vacuum applied to the under side of this plate pulls the water and pulp through these narrow slots.

The pulp is usually washed before the first screening or between the various types of screens, and again after it passed the final screen. Washing takes place in a dekker, a larger cylindrical framework covered with wire mesh.

Slippery floors, steps, and platforms present the principal hazards in washing and screening. Water and stock frequently splash into the areas surrounding the operations thereby causing injury-producing slips and falls. There is also the possibility of getting caught in the revolving screens or in the moving parts of the washers. The caustic still remaining in the pulp at this stage is strong enough to cause chemical burns, particularly to the eyes.

Bleaching

Most soda and sulfite pulps are bleached after being screened and washed, but the greater proportion of sulfate pulp is left unbleached or only partly bleached. Sulfate pulp, having the strongest fibers, is primarily used for wrapping paper, bags, container board, or other products not requiring a white finish. Bleaching liquor is usually made at the mill from chlorine and lime. The pulp is first subjected to a chlorine bath, then to a clear water bath. This may be repeated six or more times for sulfate pulp and three times for sulfite pulp. For semibleached sulfate, no more than three bleachings are required.

The principal hazards connected with bleaching are associated with the chlorine and caustic soda used in making the bleach liquor. The inhalation of chlorine results in moderate to very serious injuries, depending upon the amount inhaled. Contact with caustic soda may result in severe chemical burns. Floors in the area of the bleachers and bleach washers are often wet and slippery.

Beating

Beating is usually considered the first step in the manufacture of paper, the processes up to this point being considered as pulping operations. The washed pulp is pumped from the bleachers and dekkers to a storage chest or directly to the beater, an oval-shaped tub with a partition extending part way down the center. On one side of the partition is a ridged beater roll which revolves against a bedplate. As the beater roll revolves in paddlewheel fashion, the pulp is drawn between it and the bedplate and circulated around the partition, passing each time around between the roll and bedplate. This fibrillates and hydrates the fibers in the pulp, the amount of fibrillation and hydration depending upon the distance of the beater roll from the bedplate. Fibrillation causes the fibers to be roughened and frayed, which helps the fibers carry more water and cohere or mat together more easily.

From the beater the stock is pumped to the beater storage chest and from the storage chest to the Jordan, which further refines the pulp. The Jordan consists of a conical shell and a plug which rotates at high speed. The plug corresponds to the beater roll and the inner surface of the shell to the bedplate. The degree of refining in the Jordan can be regulated by moving the rotating plug in or out, thus changing the distance between the inner surface of the shell and outer surface of the plug.

In addition to preparing the fiber, the beaters are often used as mixing vessels in which various types of pulps and other materials are combined to produce the desired grade and type of paper. The most common additives are clay, size, alum, and dye.

Beaters are also used to repulp partially finished paper, which has been torn or found imperfect while going through the paper-making machines. This material, called "broke" is usually introduced into the beaters by hand. Similarly, cakes or "laps" of partially dried pulp shipped in from other mills or drawn from storage may be added to the mixture. In some instances the laps may be shredded before being introduced into the beater. Frequently, however, they are fed directly into the beater roll. For this operation

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the beater man uses a long paddle to guide the laps to the nip point.

The floor in the beater room is frequently quite slippery because of the water and stock which may splash from the beaters. This splashed stock may also produce chemical irritations, particularly if it gets into the beater man's eyes. In manually feeding broke, laps, or other materials, the beater man faces the possibility of falling into the tank. Tending the equipment also involves the possibility of getting caught between the beater roll and the bedplate or in the power-driven gears or pulleys when they are not properly enclosed. Broke-beater men often have to handle heavy rolls or slabs of broke which may cause strains and sprains. Knives used to cut slabs from rolls of broke sometimes slip, thereby inflicting lacerations. Broke is usually hauled to the broke beater room by broke cart or hand truck. Truckers may sustain sprains or strains when pushing or pulling the trucks.

Paper Making

After beating and refining in the beaters and Jordans, the stock is further diluted with water and pumped to the head box of the paper machine. The most widely used paper machine is the Fourdrinier. The sheet is formed on this machine in the following manner: From the head box the pulp flows onto the Fourdrinier wire, a fine wire mesh screen made in the form of an endless belt. This belt vibrates laterally as it moves forward, causing the fibers to form a matted web. As the wire carries the sheet to the presses, a dandy roll flattens and smooths out the fibers. Much of the water drains by gravity through the wire screen and still more is extracted by suction boxes, leaving a wet matted layer. The wire carries the matted layer to the first wet felt, an endless belt which carries the paper through the rolls. The presses consist of three pairs of rolls which squeeze out still more water and smooth the web.

The sheet is then picked up by the second felt and carried through the second press rolls. The operation is repeated by the third set, each set squeezing out additional water. The paper carries its own weight from the last press to the dryers. The dryer part of the Fourdrinier consists of a series of rotating cylinders, steam-heated to about 260 degrees surface temperature. The number of dryers in a unit varies. Staggered one over the other, they may extend several hundred feet. From the dryers the paper carries its own weight to the calender stack. The stack consists of a set of seven highly polished steel rolls. As the paper passes through the nips of the rolls, tremendous pressure imparts a smooth finish. As the paper leaves the stacks it is wound on a reel, then carried by crane to the finishing room, where it is reduced and packed in sizes specified by the customer or for subsequent converting processes.

Paper stock runs on the wet end of the machine as almost 100 percent water. In most plants some of this water splashes or runs on the floor around the wet end of the machine presenting a slipping hazard. Steps and catwalks on the machine also become wet and slippery, and make footing hazardous. Spots of oil are also found on and about the machine. The more serious accidents in the machine room result from getting caught in the inrunning nips of rolls on the machine. There is danger of getting caught in the nips when taking over a break, cleaning off the rolls, or straightening the felt. The majority of nip accidents, however, occur while threading the stacks or while working on the winders. Weights sometimes drop from levers and strike employees. Handling winder shafts is the source of many injuries which occur when the shafts slip from the hands of winder men or roll off the winder tables. Fingers are often mashed between shafts and winder cradles. Loose pieces of broke accumulate around the dry end of the machine and present slipping hazards.

Coating

In plants producing fine coated papers, coating machines are necessary. There are several types in use, a common type being a brush coating machine. In this process the coating material, consisting of a mixture of one or more mineral compounds with enough adhesive to bind it to the texture of the paper, flows on the ribbon of paper and brushes distribute the mixture evenly on both sides of the paper. As the paper leaves the machine it is passed over a series of ducts and nozzles emitting jets of hot air which hold the ribbon of coated paper in mid-air as it passes through the drying chamber.

Some Fourdriniers have been equipped with coating units which apply the coating midway in the drying process. The paper passes through two rollers which have been evenly coated by contact with other rollers and in turn impart the coating uniformly to the paper. The paper then passes through the remaining dryers and calender stacks to the reels.

Finishing and Shipping

There is no clear-cut demarcation between machine-room operations and finishing-room operations, some mills performing operations in the machine room which other mills perform in the finishing room. Assuming that the machine-room operations end with the finished paper coming off the calender and being wound on the reel, the next operation would be super-calendering in the finishing room. If the paper requires more finish than can be obtained in the calender rolls, the rolls of paper are transferred by overhead cranes to the super-calenders. The super-calender stack has alternating rolls of highly polished steel and highly polished paper. After super-calendering the paper may be rewound into rolls and cut, slit, or trimmed to sizes specified by the customers' orders. As the sheet passes through the rewinder, sharp discs slit the paper into the desired widths and a knife on a revolving cylinder cuts the paper to the desired length. If paper of more exact dimensions than that cut on the cutters is required, it is trimmed on a guillotine trimmer. After inspection and counting, it is packaged in rolls, bundles, cartons, or otherwise as required and then stenciled for shipment. In the shipping department, towmotors or hand trucks are used to load the paper into boxcars or trucks for shipment to its destination.

In the finishing room it is often necessary to thread the super-calenders by hand. This involves the hazard of getting fingers caught in the inrunning nips, which may result in serious injuries to the tips of the fingers. Lacerations and amputations may result from accidents occurring on the cutters and trimmers. Serious accidents may result from getting caught between the rolls on the rewinder. Vehicular accidents occur frequently in this department. Typical are those in which the employee is struck by the industrial trucks or is caught between trucks and other equipment or objects. Bruised or fractured toes may result from being run over by trucks. Sprains may occur from pulling or pushing heavy loads. Strains are sustained in lifting, and feet and hands are injured by falling and rolling paper. Crane accidents are prevalent in the finishing department. These usually occur when the claws or a roll of paper on a moving crane strike the employee. Skids are also a source of many accidents. These are often stacked in piles or stood on end and fall on employees. Some have projecting slivers which cause puncture wounds. Sprains and strains may be sustained from lifting or handling these skids.

All the hazards connected with handling and moving paper in the finishing room also exist in the shipping department. Additional hazards arise in loading box cars. Many accidents occur because of dock boards slipping or truck wheels running off dock boards. In loading, rolls of paper may roll or slide down on the car loader.

Rag and Waste-Paper Pulping

In many plants rags and waste paper are worked over and used for paper. The rags are first sorted and buckles, buttons, and other articles removed. The rags are then weighed and passed through a revolving duster where they are thrashed free of dust, which drops through a screen at the bottom. They are then carried by conveyor to the rag cutter. The rag cutter consists of a revolving drum on which there are four cutting knives and a bedplate with cutting edge. The drum rotates at high speed and chops the rags into small pieces as they are fed to the knives by a feed roll. The chopped rags are put in a large horizontal boiler and cooked under pressure with milk of lime. After cooking, the stock is beaten and washed in a combination washer and beater. Bleaching chemicals are usually added and washed out in this machine. Further processes are about the same as for wood pulp.

Old papers being reprocessed are first sorted according to the pulping process used in the original manufacture. Usually, printed paper is separated from nonprinted paper. The printed paper is soaked in chemicals which remove the ink. The paper is reduced to pulp in a hydropulper or other machine and then goes through the usual processes of washing, beating, and screening.

In rag and waste paper processing, it is necessary to handle large bales of rags and paper. Although most of this handling is done by mechanical equipment, lifting and handling injuries still occur. Glass and other sharp-edged materials are often mingled with rags and paper, causing lacerations and puncture wounds. Bales are commonly handled with hand hooks, which can inflict severe puncture wounds. Knives used to open the bales may slip, thereby causing lacerations. There is a possibility of contracting diseases by handling contaminated materials. The atmosphere around the cleaning and cutting operations is often very dusty. There is danger of getting caught in the conveyors or cutters and shredders. Further pulping and paper making processes are the same as those for wood and the hazards are essentially the same.

Factors in the Injury Record

The injury record of any plant or of any group of plants is a composite of a great many factors. The kinds of material processed; the types of processing performed; the safety regulations of the States in which the plants are located, and the extent to which those regulations are enforced; the kind of personnel employed; the size of the plants; and the extent of the safety programs carried on in the plants all have a direct bearing upon the volume of injuries experienced. In particular instances the influence of these factors may offset each other, but in comparisons based upon large groups of operations their effects frequently can be demonstrated, as in the following breakdowns of the 1948 experience of the pulp and paper manufacturing industry.

Product Comparisons

The plants engaged exclusively in manufacturing pulp had a comparatively high injury-frequency rate, 26.7. Their record also showed a relatively high incidence of fatal and permanent-impairment cases as well as a high average time loss for their temporary-total disabilities. As a result, the average time charge per disabling injury [6] in these plants was 175 days and the severity rate [7] was 4.7, both considerably higher than the corresponding averages for all pulp and paper plants. (See appendix, table 1.)

In the general group of paper-making plants, those manufacturing building paper had the lowest injury-frequency rate, 11.8. Their fatality rate, however, was above average and their average time loss per temporary-total disability was high. This gave them a high average time charge per disabling injury, 215 days. The influence of their low frequency rate, however, held their severity rate to 2.5.

In contrast, newsprint and absorbent-paper plants had injury-frequency rates of 37 and 36, respectively. Neither of these groups, however, had any death cases, and the absorbent-paper plants reported no permanent-impairment cases. Their very high frequency rates, therefore, were balanced by very good injury-severity records.

The 4 groups of plants manufacturing book-paper, coarse paper, special industrial paper, and tissue paper all had frequency rates of less than 20. The book-paper and tissue-paper plants also ranked very low in injury-severity rates. The coarse-paper and special industrial paper plants, on the other hand, stood relatively high in the severity comparisons.

Fine-paper plants had a frequency rate of 20.2, but their injury-severity rate ranked much better than average. Sanitary-paper stock plants, on the other hand, had a relatively high frequency rate, 24.8, coupled with a rather high injury-severity. The average time charge per disabling injury for these plants was 156 days and the severity rate was 3.9. The groundwood-paper plants similarly had high frequency and severity rates, 26.3 and 3.0, respectively; but the average time charge per case (112 days) was not particularly high.

[6] The average time charge is computed by adding the days lost for each temporary-total disability to the standard time charges for fatalities and permanent disabilities, as given in Method of Compiling Industrial Injury Rates (approved by the American Standards Association, 1945), and by dividing the total by the number of disabling injuries.

[7] The severity rate is the average number of days lost or charged for each 1,000 employee-hours worked.

For the 4 groups of paperboard plants, the injury-frequency rates were 13.6 for those manufacturing special paperboard stock; 17.5 for the building-board plants; 23.6 for the container and boxboard plants; and 34.4 for the wet machine-board plants. Injury severity tended to be high in each of these groups. The wet machine-board plants had a very high ratio of fatalities, and the special paperboard stock plants had a very high ratio of permanent-partial impairments. The most striking element in the record of the container and boxboard plants was the unusually high incidence of permanent-total disabilities—1 in every 12 million employee-hours worked, as compared with 1 in every 95 million employee-hours for all other plants surveyed.

Regional and State Comparisons

Variations in injury rates among the different States and regions may reflect any one or any combination of several factors. State safety regulations and the degree to which they are enforced, the age and maintenance of plants and their equipment, and employment factors, such as the experience of available workers, all tend to influence the average level of injury rates in any area.

The wide variations noted in the average rates for plants producing different types of products in the pulp and paper industry, indicate that the composition of the industry in any area, in terms of products, may also have much to do with the general level of injury rates in that area. For example, the highest national average frequency rates were for plants manufacturing newsprint, absorbent paper, and wet machine board. Any area in which these particular operations constitute a high proportion of the total production, therefore, would logically be expected to have a comparatively high over-all average regardless of other factors which might influence the rate. Because of these variable internal weighting factors, the significance of comparisons among the States and regions on the basis of industry-wide averages may be questioned. The most realistic area comparisons, therefore, are those based upon specific types of production rather than upon industry totals. (See appendix, table 2.)

Pulp Plants.—Average injury rates for plants engaged exclusively in manufacturing pulp could be computed for only two States. These were widely different. In Maine, 5 pulp plants had an average frequency rate of 17.0, which was well below the national average of 26.7. In New York the average for 3 plants was 34.4. For injury severity, however, the comparison was sharply different. The Maine plants reported 1 fatality and 3 permanent impairments, which gave them an average time charge of 256 days per case and a severity rate of 4.3. The New York plants, on the other hand, reported no deaths and no permanent impairments, which held their average time charge down to 25 days per case and their severity rate to 0.9. It is interesting in this connection to note, however, that the average time lost in temporary-total disability cases in Maine was only 17 days, whereas in New York it was 25 days. This is unusual in that the average time lost in temporary-total disabilities usually varies inversely with the frequency-rate level rather than directly as in this instance.

Bookpaper Plants.—Average rates for plants manufacturing bookpaper were computed for five States. The lowest frequency rates were for the Pennsylvania plants, 13.2, and the Wisconsin plants, 13.9; the highest was for the Maine plants, 29.7. In the middle range, the Michigan plants had an average of 17.4 and the New York plants an average of 17.9. The national average for bookpaper plants was 16.9.

The Michigan bookpaper plants had by far the best injury-severity record. The plants in that State reported no fatalities and no permanent impairments. Their average time charge per disabling injury, therefore, was only 14 days and the severity rate was only 0.2. None of the other four State groups reported fatalities, but each had one or more cases of permanent impairments. The Maine plants, nevertheless, held the average time charge down to 27 days and the severity rate to 0.8. In contrast, the average time charge for the New York plants was 138 days and the severity rate was 2.5.

Fine-Paper Plants.—Injury rates covering the manufacture of fine paper were computed for eight States. As against the national average of 20.2 for this type of plant, the frequency rates for these States covered a very wide range: 14.2 in

Wisconsin; 14.7 in New York; 16.8 in Pennsylvania; 22.8 in Maine; 23.8 in Massachusetts; 32.1 in Michigan; 36.4 in New Jersey; and 43.7 in Ohio.

All of the injuries reported by the fine-paper plants in Massachusetts were temporary-total disabilities. Their average time charge, 17 days per case, and the severity rate, 0.4, were, therefore, very low. The only fatality reported by a fine-paper plant occurred in Wisconsin. Coupled with several permanent impairments, this gave the Wisconsin plants an average time charge of 127 days and a severity rate of 1.8. In New York, however, a large proportion of relatively serious permanent impairments yielded a much higher average time charge, 220 days, and a severity rate of 3.2. In Ohio the high frequency rate forced the severity rate up to 3.3 although the average time charge, 75 days, was not unduly high. Maine, Michigan, and Pennsylvania each had relatively good severity averages.

Coarse-Paper Plants.—Four State frequency rates were computed for plants manufacturing coarse paper: Louisiana, 16.4; New York, 20.7; Ohio, 25.9; and Wisconsin, 37.5. All of these, except the Louisiana rate, were well above the national average of 16.7. The high frequency rate in Wisconsin, however, was balanced by a relatively low average time charge of 20 days per case and a similarly low severity rate of 0.7. In Ohio, where the total coverage was quite small, 1 death and 3 permanent impairments in a total of only 28 reported injuries drove the average time charge up to 265 days and the severity rate to 6.9. Although the New York plants had no death cases, their high ratio of permanent impairments gave them an average time charge of 117 days and a severity rate of 2.4. In Louisiana, the effect of a death case was balanced by a relatively low volume of permanent impairments to produce an average time charge of 111 days and a severity rate of 1.8.

Sanitary-Paper Stock Plants.—State averages for plants manufacturing sanitary paper stock were available for Wisconsin and New York only. In Wisconsin the injury-frequency rate was 18.4. In New York it was 22.5. Both of these rates were lower than the national average of 24.8.

Despite the inclusion of a death case in their record, the Wisconsin plants also had the better severity record. Their average time charge was 92 days and the severity rate was 1.7. The corresponding averages in New York were 274 days and 6.2.

Tissue-Paper Plants.—The four-State frequency rates for tissue-paper plants showed an extremely wide variance. In Pennsylvania the frequency rate was 6.2, in Wisconsin 8.7, in New York 32.9, and in Massachusetts 84.5. For comparison, the national average was 19.7.

Offsetting its very high frequency rate, Massachusetts had the best injury-severity record among the four States.

The Massachusetts plants reported no deaths and no permanent impairments, and recorded a very low average time loss for temporary injuries. Their average time charge, therefore, was only 7 days and their severity rate 0.6. The Wisconsin plants reported some permanent impairments which lifted their average time charge to 33 days per case, but the low injury frequency held their severity rate to 0.3. In Pennsylvania the average time charge, influenced by 2 relatively serious permanent impairments, was 253 days per case, and the severity rate was 1.6. The New York report included both a death and a relatively high proportion of permanent impairment cases. As a result, their average time charge was 250 days and the severity rate was 8.2.

Container and Boxboard Plants.—Eleven State averages were computed for boxboard plants. As against the national average of 23.6, the lowest frequency rate in this group was 9.4 for North Carolina. The highest was 51.6 for New Jersey. California's average rate of 18.6, Ohio's 21.2, Michigan's 21.7, and New York's 23.1 were slightly below the national figure. In the higher range, Illinois had a frequency rate of 29.8, Georgia, 30.0, Connecticut, 37.3, Indiana, 41.3, and Pennsylvania, 44.9.

Indiana, Pennsylvania, Illinois, and Connecticut had the most favorable injury-severity records. No deaths were reported by any of the boxboard plants in these States, and there were no permanent impairments in the Indiana plants. The North Carolina and California plants reported no death cases, but relatively high proportions of permanent impairments. North Carolina's aver-

age time charge was 438 days per case, higher than for any other State, but her severity rate of 4.1 was exceeded by three other States. Three deaths were reported in Michigan boxboard plants, but these cases were partially balanced by a comparatively low ratio of permanent impairments. Two deaths were reported in Ohio and one in Georgia. In Georgia, however, the death case was accompanied by 5 permanent impairments in a total of only 49 disabling injuries. This gave Georgia an average time charge of 171 days and a severity rate of 5.1. New York, with a death, a permanent-total disability, and 9 permanent-partial disabilities in a total of 142 injuries, had an average time charge of 197 days and a severity rate of 4.5. New Jersey's very high frequency rate was accompanied by a very high severity rate, 13.8, as well as a comparatively high average time charge of 268 days per case.

Building-Paper Plants.—All of the three State frequency rates computed for plants manufacturing building paper were comparatively low in terms of the 11.8 national average. In California the average frequency rate was 5.2; in Illinois, 12.3; and in Pennsylvania, 12.5.

The injury severity in the California and Illinois plants tended to be quite high in contrast to their low frequency rates. The average time charge was 346 days per case in California and 308 days in Illinois. Their severity rates were also comparatively high, 3.8 in Illinois and 1.8 in California. The Pennsylvania plants, on the other hand, had no death or permanent impairment cases and achieved a very low average time charge of 13 days per case with an equally favorable severity rate of only 0.2.

Interplant Comparisons

The range of frequency rates among the reporting plants was extremely wide. Fifty-two plants had frequency rates of zero and 13 had rates of over 100. The zero-rate plants were all relatively small; only 7 had as many as 100 employees and only 1 of these had as many as 250 employees. The plants at the top of the range were also relatively small; 10 had fewer than 100 employees each, and none of the other 3 had as many as 250 employees. (See appendix, tables 3, 6, and 7.)

Approximately a fourth of the reporting plants had injury-frequency rates of 40 or higher. This group accounted for only about 10 percent of the total employment in the sample, but they reported nearly 30 percent of the total volume of injuries. At the other end of the range, another group of plants, also constituting approximately a fourth of the sample, had frequency rates of less than 9.0. This group of plants had 27 percent of the total employment, but reported less than 7 percent of the total volume of injuries.

Approximately half of the reporting plants had frequency rates in the range between 9.0 and 40.0. These plants, accounting for about 63 percent of the total employment in the sample, reported 64 percent of the injuries. The highest concentration of plants fell in the frequency-rate range of 15 to 20. About 12 percent of the plants had rates in this narrow range. As a group they accounted for slightly more than 15 percent of the total employment and just over 13 percent of the reported injuries.

Plant Size Comparisons

Previous studies in other industries have shown that there is often a direct correlation between injury-frequency rates and plant size. In some instances the average frequency rate varies inversely with plant size throughout the plant size range. In other instances the very small plants have comparatively low rates, approaching the level of the rates for the large plants, with the highest rates occuring in the medium-size plants.

The common finding that the larger plants tend to have lower than average frequency rates has generally been interpreted as reflecting the organized safety programs frequently found in those plants. The occurrence of low average rates in the very small plant group similarly has been rationalized as reflecting the close personal supervision exercised by the plant owners. The higher rates for medium-size plants in contrast have been attributed to the fact that these shops are too large for intimate supervision by top management and too small to have regularly established safety departments.

The breakdown of injury experience by plant size in this pulp and paper survey did not show a frequency-rate differential in favor of the very small plants. However, it did show a definite inverse relationship between the frequency-rate

levels and plant size. In the plant-size range below 250 employees there was a striking similarity in the average frequency rates of the three size groups for which rates were computed. The plants employing fewer than 50 workers had an average rate of 31.4; those employing 50 to 99 workers had a rate of 35.4; and those employing 100 to 249 workers had a rate of 33.3. Since variations of this order are of doubtful significance, these rates, for all practical purposes, may be assumed to be identical. Up to the 250-employee level, therefore, plant size variations appear to have had little bearing upon the occurrence of injuries.

Above the 250-employee level, however, there was a sharp break in the average frequency rates. For plants with 250 to 499 workers the average frequency rate dropped to 26.1, and for those with 500 to 749 workers it dropped to 17.1. With each successively larger employment step the average rate declined further, reaching its lowest level of 9.6 for plants employing 1,500 to 1,999 employees. For the very large plants at the top of the range—i. e., those employing 2,000 or more workers apiece—the average rate reversed its downward movement and rose to 16.0. This upswing in the rate reflected the experience of 4 plants in this 12-plant group—one had a rate of over 35 and 3 had rates ranging between 20 and 25.

Safety Programs

An unusually high proportion of the plants in the pulp and paper industry maintain organized safety programs. In large measure it is this fact which accounts for the industry's excellent record of reducing its frequency rate so sharply during the last 5 years.

Over 75 percent of the 534 plants surveyed reported that they had some form of organized safety program. Full-time safety engineers were employed in 148 plants, and in 137 of these the activities of the safety engineer were supplemented by formally organized safety committees. In the group with no full-time safety engineer there were 254 which had organized safety committees. Only 102 reported having neither safety committees nor safety engineers. Twenty-seven plants did not report regarding their safety activities and eight did not report on all details of their programs. (See appendix, table 4.)

It is recognized that in a broad comparison covering a wide variety of plants of greatly differing sizes and complexities of organization, the employment or nonemployment of a safety engineer may simply be a reflection of the development of the individual plant safety programs rather than the controlling factor in a plant safety record. Nevertheless, it appears significant that of the 507 plants reporting on this point, the 148 with full-time safety engineers had an average frequency rate of 15.3 compared with 25.5 for the 359 plants with no safety engineer. In terms of exposure (man-hours worked) death cases and permanent-total disabilities occurred twice as frequently in the plants without safety engineers as in those employing safety specialists. Similarly, temporary-total disabilities occurred 70 percent more frequently in the plants with no safety engineer. The frequency of permanent-partial impairments, however, was about the same in both groups of plants.

Despite their higher frequency of fatalities, the plants without safety engineers had a somewhat lower average time charge per injury than those with safety engineers. This was primarily because of their higher proportion of temporary-total disability cases and to a substantially lower average time-loss for those cases. The latter element emphasizes the fact that the plants employing safety engineers also generally had more elaborate medical departments, which in turn was an added factor tending to hold down the frequency rate for this group of plants.

It is to be noted that the average employment was over 750 workers in plants having full-time safety engineers. In the group not employing safety engineers the average was slightly under 250 workers.

A large proportion of the plants employing safety engineers also reported that their safety programs included some form of organized employee participation through safety committees. This was also reflected in the frequency rates. The 11 plants with safety engineers, but no safety committees, had an average frequency rate of 19.0 in contrast to the average of 15.1 for the 137 plants with both safety engineers and some form of safety committee organization.

Within the latter group there appeared to be a significant correlation between injury frequency and the manner in which the safety committees

were organized. In 12 plants, the committees were composed entirely of supervisory employees. The average frequency rate for this group was 17.5. In 110 plants, the safety committees were composed of both supervisory and nonsupervisory employees—their average frequency rate was 15.5. In a third group of 11 plants, where the safety committee membership was limited to nonsupervisory employees, the average frequency rate was 8.9. In general, throughout these comparisons the average time charge and the severity rates of the different groups varied in the same manner as the frequency rates.

The significance of these variations in the experience of the plants with full-time safety engineers was enhanced by an almost identical pattern of variations within the group of plants without safety engineers. Within the latter group, 102 plants had neither safety engineers nor safety committees. These plants had an average frequency rate of 31.1, whereas the 254 plants reporting safety committees, but no safety engineer, had an average rate of 24.7. In the breakdown according to the composition of the committees, the average frequency rates were: 25.9 for 58 plants in which the committees were composed of supervisory employees; 24.6 for 178 plants where both supervisory and nonsupervisory employees served on the committees; and 22.4 for 17 plants in which only nonsupervisory employees were members of the committees. Again, the severity of injuries, as measured by the average time charge and the severity rates, in these groups of plants tended to follow the same general pattern of the frequency rates.

Medical and First-Aid Programs

A very large proportion of the reporting plants indicated that they maintained an organized first-aid or medical program on their premises. A similarly large proportion indicated that they required preemployment physical examinations for all new employees for the purpose of assisting in making proper job assignments.

A total of 515 plants reported on their medical and first-aid plant facilities. Of these, 383 had specially equipped first-aid rooms which were open and attended throughout the working hours. In 174 plants the first-aid rooms were operated by professional attendants; i. e., by a doctor or a registered nurse. In the other 191 plants the first-aid rooms were operated by nonprofessional attendants who in most instances had been given some first-aid training. Practically all the plants with no established first-aid rooms reported that they maintained first-aid kits on the premises.

Replies relating to preemployment physical examinations were received from 491 plants, of which 340 reported that they required such examinations. The great majority of these were plants which also maintained organized first-aid programs on the premises.

In general, the existence or nonexistence of a medical or first-aid program appeared to be closely related to plant size. Plants with first-aid rooms under professional management had an average employment of over 800 workers. Those with first-aid rooms operated by nonprofessional attendants averaged 200 workers, and those depending upon first-aid kits averaged 130 workers. Similarly, plants requiring preemployment physicals had an average of nearly 500 employees in contrast to about 125 for those not requiring such examinations.

Because of this close association with plant size it is probable that injury rates for groups of plants classified on the basis of their medical and first-aid programs also reflect the influence of many other factors. Efforts were made to break down the sample to show rates for groups of plants which were similar in all respects except medical and first-aid programs. This effort, however, failed to yield significant results because of the many plant differences which had to be reconciled and the comparatively small samples available. It was impossible, therefore, to secure objective statistical evidence of the influence of medical and first-aid programs upon the occurrence of work injuries.

It is interesting, however, to note that the average time lost in temporary-total disability cases was 14 days in the plants with no first-aid room and 18 days in those having first-aid facilities. Although injury treatment facilities on the premises may not actually prevent injuries, their availability apparently avoids loss of time for many minor injuries which might otherwise result in the loss of 1 or 2 days' time.

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Departmental Injury Rates

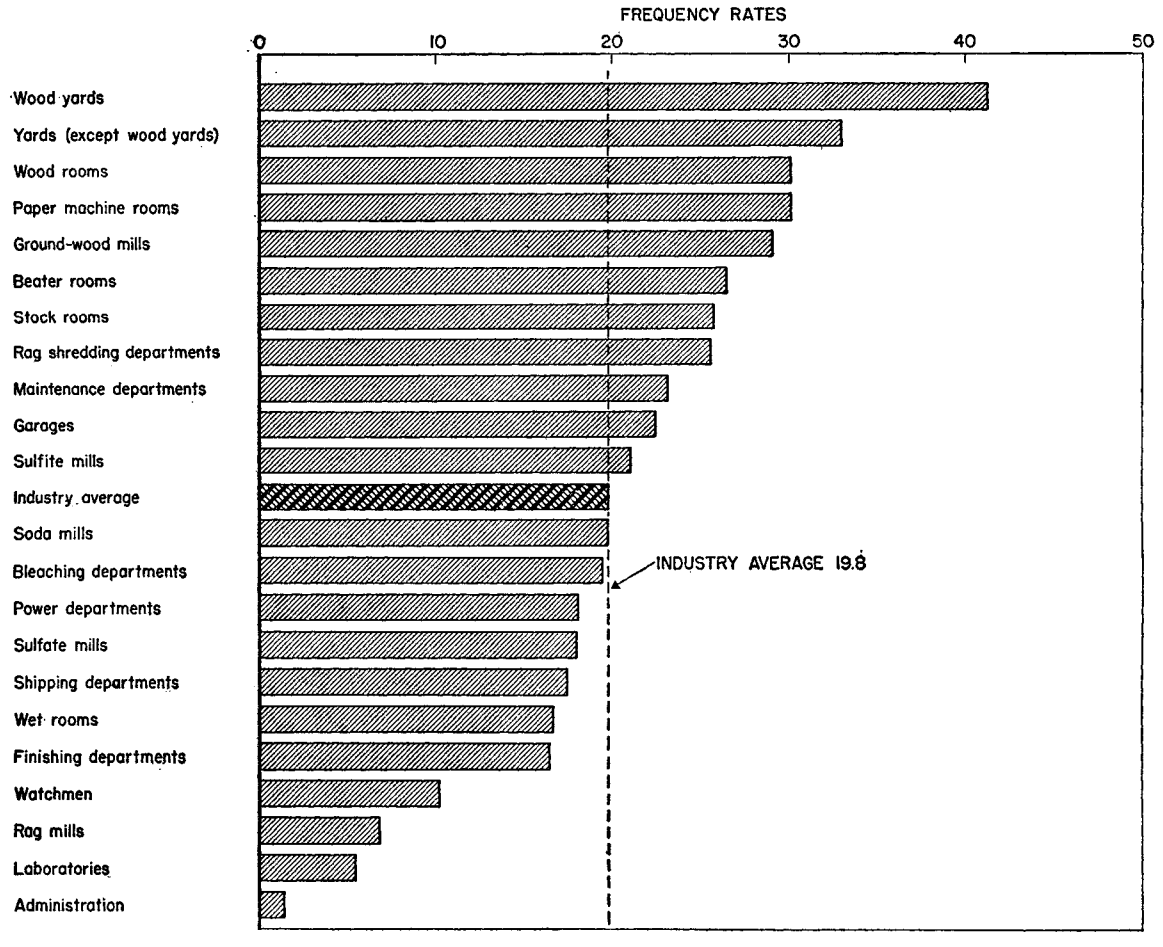
Because the internal organization of the reporting plants differed greatly, many were unable to furnish complete breakdowns of their operations according to a standardized pattern. Nearly all, however, reported on some of their operations in sufficient detail to permit the inclusion of those figures in typical departmental groups. On this basis, separate injury records were compiled for 14 standard production departments or operations. (See appendix, table 5.)

Production Departments

Injuries were most common in the woodyards. Because of the very high frequency rate, 41.3, their severity rate, 3.3, was somewhat above average; but the average time charge per injury, 79 days, was comparatively low.

The wood rooms and the paper-machine rooms had identical frequency rates, 30.1. Both of these departments had a high incidence of serious

CHART 2. DISABLING INJURY-FREQUENCY RATES IN THE PULP AND PAPER INDUSTRY, BY DEPARTMENT, 1948



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injuries. Wood rooms had the highest severity rate recorded, 6.4, and their average time charge of 214 days was exceeded by only one other production department. For the paper-machine rooms, the severity rate was 5.0 and the average time charge, 167 days.

The rag-shredding departments, the groundwood mills, the sulfite mills, and the beater rooms all had frequency rates ranging between 20 and 30. No deaths were reported in the groundwood mills, rag-shredding departments, or the sulfite mills. As a result, their severity records were relatively good, although they each had some permanent-partial impairment cases. In the beater rooms the proportion of permanent-partial impairments was low, but the ratio of death cases was relatively high, giving them an average time charge of 125 days per injury and a severity rate of 3.3.

Sulfate mills, soda mills, wet rooms, bleaching departments, finishing departments, and converting departments had frequency rates ranging between 10 and 20. The sulfate mills had a rather high proportion of death and permanent-total disability cases. The soda mills had some serious permanent-partial impairments. The wet rooms and the bleaching departments, with no death and very few permanent impairments, had outstandingly good severity records.

The rag mills had the most favorable record among the production departments. They reported no death or permanent impairment. Their frequency rate was only 6.8; their severity rate 0.1; and their average time charge, only 9 days per injury.

Service and Maintenance Departments

The highest frequency rates in the service and maintenance group were for the yard (33.0), stockroom (25.8), plant maintenance (23.2), and garage (22.5) departments. The yard departments, however, had a very good severity record to balance their high frequency rate. The garage departments reported no death cases, but a high ratio of permanent impairments gave them a severity rate of 5.7 and an average time charge of 253 days per disabling injury. The plant maintenance departments had approximately 12 percent of all the reported employees, but they reported 15 percent of all the injuries—1,362. These injuries included 6 deaths, 1 permanent-total disability, 102 permanent-partial disabilities, and 1,253 temporary-total disabilities.

The power-plant departments had an average frequency rate of 18.1; the shipping departments, 17.5; and the watchmen's department, 10.2. The lowest of the departmental frequency rates were 5.4 for the laboratories and 1.4 for the clerical and administrative personnel. The severity rates for these two groups were quite low, but the average time charges per disabling injury were above average.

Kinds of Injuries Experienced

Individual case records were collected in this survey for 3,285 disabling injuries and for 2,960 injuries requiring medical attention but not resulting in loss of time after the day of injury. The disabling cases included 12 fatalities, 2 permanent-total disabilities, 150 permanent-partial disabilities, and 3,121 temporary-total disabilities. (See appendix, tables 8 through 13.)

The definitions of these several disability classifications as applied in this survey are as follows:

(1) *Fatality.*—A death resulting from an industrial injury is classified as an industrial fatality regardless of the time intervening between injury and death.

(2) *Permanent-Total Disability.*—An injury other than death which permanently and totally incapacitates an employee from following any gainful occupation is classified as a permanent-total disability. The loss, or the complete loss of use, of any of the following in one accident is considered permanent-total disability:

(*a*) Both eyes;

(*b*) One eye and one hand, or arm, or leg, or foot;

(*c*) Any two of the following not on the same limb: Hand, arm, foot, or leg.

(3) *Permanent-Partial Disability.*—The complete loss in one accident of any member or part of a member of the body, or any permanent impairment of functions of the body or part thereof

to any degree less than permanent-total disability is classified as permanent-partial disability, regardless of any preexisting disability of the injured member or impaired body function.

The following injuries are not classified as permanent-partial disabilities, but are classified as temporary-total, temporary-partial disabilities, or medical treatment cases, depending upon the degree of disability during the healing period:

(*a*) Hernia, if it can be repaired;
(*b*) Loss of fingernails or toenails;
(*c*) Loss of teeth;
(*d*) Disfigurement;
(*e*) Strains or sprains not causing permanent limitation of motion;
(*f*) Fractures healing completely without deformities or displacements.

(4) *Temporary-Total Disability.*—Any injury not resulting in death or permanent impairment is classified as a temporary-total disability if the injured person, because of his injury, is unable to perform a regularly established job, open and available to him, during the entire time interval corresponding to the hours of his regular shift on any one or more days (including Sundays, days off, or plant shut-downs) subsequent to the date of injury.

(5) *Medical Treatment Case.*—For the purpose of this survey, any injury not resulting in death, permanent impairment, or temporary-total disability, but requiring treatment by a physician, is classified as a medical-treatment case.

Definitions (1), (2), (3), and (4) are from the American Standard Method of Compiling Industrial Injury Rates as approved by the American Standards Association, October 11, 1945. Definition (5) represents a combination of the American Standard Definitions of temporary-partial disability and medical treatment cases.

Fatalities

Three of the 12 reported fatalities resulted from blows on the head; 2 were electrocutions; 3 resulted from multiple crushing injuries; 1 was a drowning; 1 resulted from a fall; and 2 resulted from burns.

One of the three fatal head injuries occurred in the woodyard. In this instance a stacker was struck by a stick of pulpwood falling from a pile. In the second case a maintenance man was struck on the head by a chunk of concrete falling from a wall which he was repairing. The third fatal head injury occurred at the slasher saw. A section of pulpwood thrown by the saw struck the sawyer in his face.

One of the electrocutions occurred when a helper was attempting to change the air hose on a precipitator. He had cut the current on one section of the machine but had not pulled the switch for the section on which he was working. The other electrocution involved a carpenter making repairs near a 2,300-volt line. An electrician had gone to cut off the power, but the carpenter contacted the line before it was de-energized.

A woodyard laborer was crushed under the boom of a crane being used to pull a derailed freight car back onto the track. The boom cable broke under the pull and allowed the boom to fall on him. In another crushing accident, a machine tender was removing loose paper from a shaft puller. The paper caught in the nip of the winder and pulled him between the winder drum and the roll of paper, thereby crushing his chest. The third crushing fatality occurred in a vehicle accident when a lift truck operator in the receiving department backed his vehicle into the path of an oncoming highway truck. In the collision the lift truck was overturned on top of the operator.

Burns from contact with hot pulp cost the life of a diffuser operator when he was caught in a "blow-out". In this case the diffuser had "hung up" and knowing the possibility of a blow-out, the operator was trying to dump the diffuser before it blew. He was standing in front of the diffuser door when the blow-out occurred and was covered by the hot pulp. The other case of a fatal burn occurred in the woodyard. An open bucket of gasoline became ignited and the flame threatened a nearby pile of pulpwood. An unloader attempting to kick the bucket away from the wood splashed the flaming gasoline over himself and set his clothes on fire.

In the drowning case, a boom man was carrying a steel cable along the log boom race. Apparently the load he was carrying threw him off balance and he fell into the water.

The case in which death resulted from a fall was a typical unguarded elevator accident. A hand trucker pushing a load of broke pushed his truck

through an open elevator gate—but the elevator was at a higher floor. As the truck plunged into the open shaft, it pulled the operator with it.

Permanent-Total Disabilities

One of the two reported permanent-total disabilities occurred in the course of piling logs. The injured worker was on the pile when the logs started to roll. He was thrown to the concrete floor and landed on his elbows. Both elbows were shattered, permanently depriving him of the use of his arms.

The second case involved a maintenance man. He was sitting astride a conveyor preparing to tighten it when someone threw the switch, setting it in motion. Both his legs were severely mangled and were rendered permanently useless.

Permanent-Partial Disabilities

The 150 permanent-partial impairment cases included the amputation of 4 arms, 3 hands, 66 fingers, and 3 toes; 1 loss of sight in 1 eye; and 73 cases of contusions, fractures, cuts, and strains involving some residual loss of use of a body part or function.

Two of the arm amputations resulted from accidents on paper-making machines. In one instance the employee was cleaning stock from a moving press roll, when his hand caught under the felt and his arm was pulled into the rolls. In the other case, the worker was feeding sheets into a smoothing press, when his hand caught in the nip and his arm was pulled between the rolls. In the third arm case as a worker was adjusting loose paper at the winder, the paper caught his arm and pulled it through the rewinder. The fourth arm amputation involved a maintenance man who reached inside a pulverizer to check a bearing while the machine was in operation.

Two of the hand amputations resulted from workers becoming caught in the paper machine rolls. In both instances the workers were attempting to remove some stock which had adhered to one of the rolls. The third case involved a woodyard laborer who was on a barge acting as signal man for the crane operator who was picking up pulpwood from the barge. The crane bucket swung as it was lifted and pinned the signalman's hand against a barge post.

The 66 finger-amputation cases included 57 amputations of 1 finger, 6 involving 2 fingers, and 3 involving 3 fingers. One of the 3-finger amputations occurred on a coating machine. The paper had broken and the operator had pulled most of it out of the machine. When he then attempted to pull off some paper sticking to one of the squeeze rolls, his fingers were pulled into the nip point. The second 3-finger amputation occurred on a parchment machine. The operator placed his hand on a moving shaft which pulled his fingers against a bearing. In the third case a trimmer operator's foot slipped as he was feeding his machine. While off balance, his hand went under the knife.

Two of the 2-finger amputations involved machine tenders; the other four involved maintenance men. One of the machine tenders reached over the slitter roll while standing on the frame of the machine. His foot slipped and in trying to catch himself he put his hand under the cutter bar. The second operator got his fingers caught in the winder rolls while threading the machine. One of the maintenance men lost his fingers between two rolls while checking their adjustment. Another maintenance man was planing a small wedge on a jointer when the piece kicked back and his fingers slid into the blade. The third maintenance man lost two fingers when his portable electric saw slipped and struck his hand. The fourth of this group of maintenance accidents was experienced by a pipe fitter. As he was placing a heavy piece of pipe in a vertical position, it slipped and dropped on end onto his fingers.

The 57 1-finger amputations occurred under various circumstances. The great majority, however, arose from contact with moving machinery. Ten workers were caught in conveyor mechanisms; 6 while removing materials from moving conveyors, 2 while making repairs on moving conveyors, and 2 when stopped conveyors were started without warning. Nine others were caught in moving gears or pulleys; eight while making adjustments or repairs on their machines. Five workers each lost a finger by getting caught between moving rolls; two while threading calender rolls, two while cleaning calender rolls, and one while making a splice on a rewinder. Four 1-finger amputations occurred in the use of power saws and four in the operation of jointers. While cleaning or adjusting their machines, six operators were caught between a moving part and the frame or other stationary

part of the machine and lost a finger apiece. The other six 1-finger amputations which occurred on machines included: one case of contact with the knives of a knotter; one of striking against a knotter drill; one of getting caught by the wedge of a splitter; one of touching the knives of a hand barker; one of getting caught under the knife of a paper cutter; and one case of getting caught under a steam hammer.

The 13 1-finger amputations not involving machines included 10 cases in which workers crushed their fingers between objects they were lifting or moving and other stationary objects; one in which the finger was badly burned by hot rosin; one in which the finger was caught in a closing door; and one which occurred in coupling two railroad cars.

One of the toe-amputation cases occurred in the shipping department where a large gear was being moved. When the crew lost control of the gear it rolled onto the toes of one of the workers not wearing safety shoes. A somewhat similar accident involved a yard laborer. As he was placing a spare roll on a storage rack, it slipped off the rack and fell on his foot. The third toe amputation resulted from an accident in the furnace room. When a worker attempted to throw a heavy stick of wood into the furnace, it struck the side of the furnace door and fell back on his foot.

The single accident causing the complete loss of an eye occurred while a worker was cleaning out a sewer pump. Pressure in the line blew waste cooking liquor directly into his eye when he loosened a connection.

The 73 cases resulting in some permanent loss of use of a body member or function without complete amputation included 39 cases of severe contusions, 14 cuts or punctures, 17 fractures which failed to heal properly, and 3 serious muscular strains. Eight of these were arm injuries; 45, hand or finger injuries; 11, foot or leg injuries; 5, eye injuries; 2, back injuries; 1, a hip injury; and 1, an ear injury. These injuries resulted from the following accidents:

Number of cases	*Kind of accident*
45	Hand or finger injuries
16	Caught in rolls
4	Caught in pulleys or gears
2	Caught in conveyor mechanism
2	Caught in splitter
1	Caught in jointer head
1	Struck saw blade
4	Caught in pinch points of other machines
12	Pinched or struck by objects being handled
1	Struck against post
1	Fell on staging
1	Fell on slippery floor
11	Foot or leg injuries
7	Pinched or struck by materials being handled
2	Fell into moving parts of machines
1	Fell from pile of laps
1	Struck by fork truck
8	Arm injuries
2	Caught in rolls
1	Caught in car-puller cable winch
3	Falls from elevations
1	Struck by crane bucket
1	Struck by falling motor
5	Eye injuries
2	Struck by chips from hand tools
1	Struck by piece of metal thrown by Jordan
1	Fell against pipe in walkway
1	Horseplay
2	Back injuries
1	Lifting
1	Working in strained position
1	Hip injury
1	Fell on wet floor, fractured hip
1	Ear injury, loss of hearing
1	Struck by sliding log

Temporary-Total Disabilities

Nearly 36 percent of the temporary-total disabilities resulted from bruises or contusions. Another 22 percent resulted from strains or sprains; 14 percent from cuts or lacerations; and 12 percent from fractures. Temperature burns accounted for over 4 percent of the total; hernia cases for nearly 4 percent; and chemical burns for over 2 percent.

Measured in terms of average time lost per case, the hernia and fracture cases were the most serious types of temporary-total injuries. In terms of total time lost to the industry, however, the cases of bruises and contusions accounted for nearly 30 percent of the time lost because of temporary-total disabilities; sprains and strains

accounted for 22 percent; fractures for 21 percent; cuts and lacerations for over 10 percent; and hernias for 8 percent.

About half the bruises and contusions were foot and leg injuries and another third were hand and arm injuries. Nearly half the strains and sprains were back injuries and 20 percent were foot injuries. Nearly half the cuts and lacerations were hand or finger injuries; another fourth were foot or leg injuries. Forty-six percent of the fractures were foot or toe injuries; 22 percent hand or finger injuries; 9 percent leg injuries; 7 percent broken ribs; and 6 percent arm injuries. The temperature burns causing lost time occurred more or less equally to all parts of the body. Chemical burns on the other hand, were primarily eye and foot injuries.

The general distribution of temporary-total disabilities indicated that 25 percent were injuries to the trunk; 24 percent, foot and toe injuries; 19 percent, hand and finger injuries; 12 percent, leg injuries; 5 percent, eye injuries; and 5 percent, arm injuries. The trunk injuries, including hernias, accounted for 34 percent of all lost time charged to temporary-total disabilities; foot and toe injuries, 23 percent; and hand and finger injuries, 14 percent.

Medical Treatment Cases

Over 32 percent of the injuries requiring medical treatment, but not resulting in loss of time other then for treatment, were bruises or contusions. Cuts and lacerations accounted for 27 percent of the medical treatment cases; foreign bodies in the eyes, nearly 16 percent; and strains and sprains, nearly 15 percent.

The medical treatment cases included a large proportion of injuries to the hand and finger, 29 percent; eye, 20 percent; foot and toe, 12 percent; leg, 7 percent; and back, 6 percent. The record indicated that in the total volume of reported eye injuries 10 required only simple medical attention without significant loss of time for every 1 resulting in a day or more of disability. For other head injuries the ratio was much lower, about 4 to 1. For injuries to the upper extremities it dropped to just over 3 to 1 and for trunk and lower extremity injuries, it dropped to 1.5 to 1. The exact significance of these ratios, of course, is open to some question, inasmuch as there is no way of knowing the volume of minor injuries in the various categories which might have benefited by medical treatment, but which were unreported.

Accident Analysis

Accident reports frequently do not show the specific reason for the occurrence of the particular events culminating in an injury. In most instances. the only available information comes from the injured person himself, or from witnesses present at the time who may lack either the skill or the opportunity to investigate the event fully to determine the actual accident cause. In the analysis of a large number of accident reports, therefore, it is common to find a large proportion deficient in the one respect most important to the safety engineer. Despite these limitations, however, the analyst can draw much useful information from even the most sketchy accident description.

Almost invariably the description of an accident tends to follow the normal line of thinking on the part of an interested person who hears that a friend or acquaintance has been injured. The first thought is of the injury itself. Was it a burn, a cut, a bruise, a strain, or something else? Then—what produced the injury and how did it happen? These are all descriptive facts which are usually readily apparent to the witnesses. They, therefore, loom large in the accounts of the events. The more analytical question, "Why did it happen?" normally arises only after the desire for descriptive information has been satisfied. It frequently goes unanswered, either because of preoccupation with the descriptive factors, or because the answer may not be readily apparent.

The direct approach in accident analysis, therefore, is to draw from the records the various elements of information in the order in which they are usually recorded. Standing alone, these elements may have limited value, but when related to each other they can do much to indicate the accident-prevention activities which may be needed. The determination of the objects or

substances most commonly producing injuries, coupled with information on how they produced the injuries, constitutes the first step toward an understanding of the accident problem. (See appendix, tables 14 and 15.)

Agencies of Injury and Accident Types

Agencies of Injury.—About a fourth of all recorded injuries resulted from some form of contact with machines or machine parts. Paper-making machines, including winders and calender stacks, were involved in 5 percent of the injuries; vehicles about 5 percent; conveyors and hoisting apparatus about 3 percent; and various machine parts, including shafts and cores, about 7 percent. A large proportion of the injuries inflicted by paper-making machines resulted from workers being caught in the moving parts, primarily at the point of operation. This was also true for winders and calenders. There were also many instances in which workers were injured simply by bumping into these machines, by falling against the machines, or by being struck either by moving parts of the machines or by parts which fell from the machines.

Hand trucks were involved in over half of the vehicular accidents—the others were primarily highway motor vehicles and railroad cars. The most common accidents involving hand trucks were those in which the injured workers were struck by the vehicles. There were also many cases of over-exertion in moving hand trucks and a considerable number of instances in which workers bumped into improperly parked vehicles or had parts of their bodies pinched between the vehicles and other objects. Crowded workplaces and poor traffic lay-out contributed to the occurrence of many of these accidents.

About half of the injuries inflicted by conveyors and a third of those inflicted by hoisting apparatus resulted from workers becoming caught in moving parts of the equipment. The most common hoisting equipment accidents, however, were those in which the injured persons were struck by swinging loads or by materials spilled from the loads.

The injuries resulting from contact with shafts, cores, and metal machine parts occurred largely during manual handling of these items. In many instances the workers dropped them upon their feet, pinched their fingers under them as they set them down, or strained themselves in attempting to lift them.

Flying particles and airborne dusts, generally unidentifiable, were responsible for about 12 percent of the reported injuries. All of these were eye injuries and in most instances were relatively minor. Their substantial numbers and the fact that some produced severe disabilities, however, makes them an important group worthy of serious consideration in the development of a safety program.

Contact with hand tools produced more than 9 percent of the reported injuries. Pulphooks were most commonly involved in these accidents, but wrenches, knives, bars, hammers, and portable power tools were each responsible for a substantial number of injuries. The pulphook injuries usually occurred when the hooks pulled out of the logs or glanced off and struck the users. The other hand-tool accidents were generally cases in which the tools slipped from the object to which they were being applied and struck the worker or pinched his hand against some other object.

Pulpwood logs were the injury-producing agencies in nearly 7 percent of the recorded cases. The great majority of the accidents involving pulpwood sticks were cases in which the workers dropped logs on their feet; pinched their fingers in piling the logs; were struck by logs rolling or falling from a pile; or strained themselves attempting to lift or move heavy logs.

Working surfaces, listed as the agency of injury in about 6 percent of the recorded cases, were involved primarily in falls. Over half the accidents in the group were cases in which the workers slipped or stumbled and fell to the surface on which they were walking or standing. Most of the others were falls from an elevation.

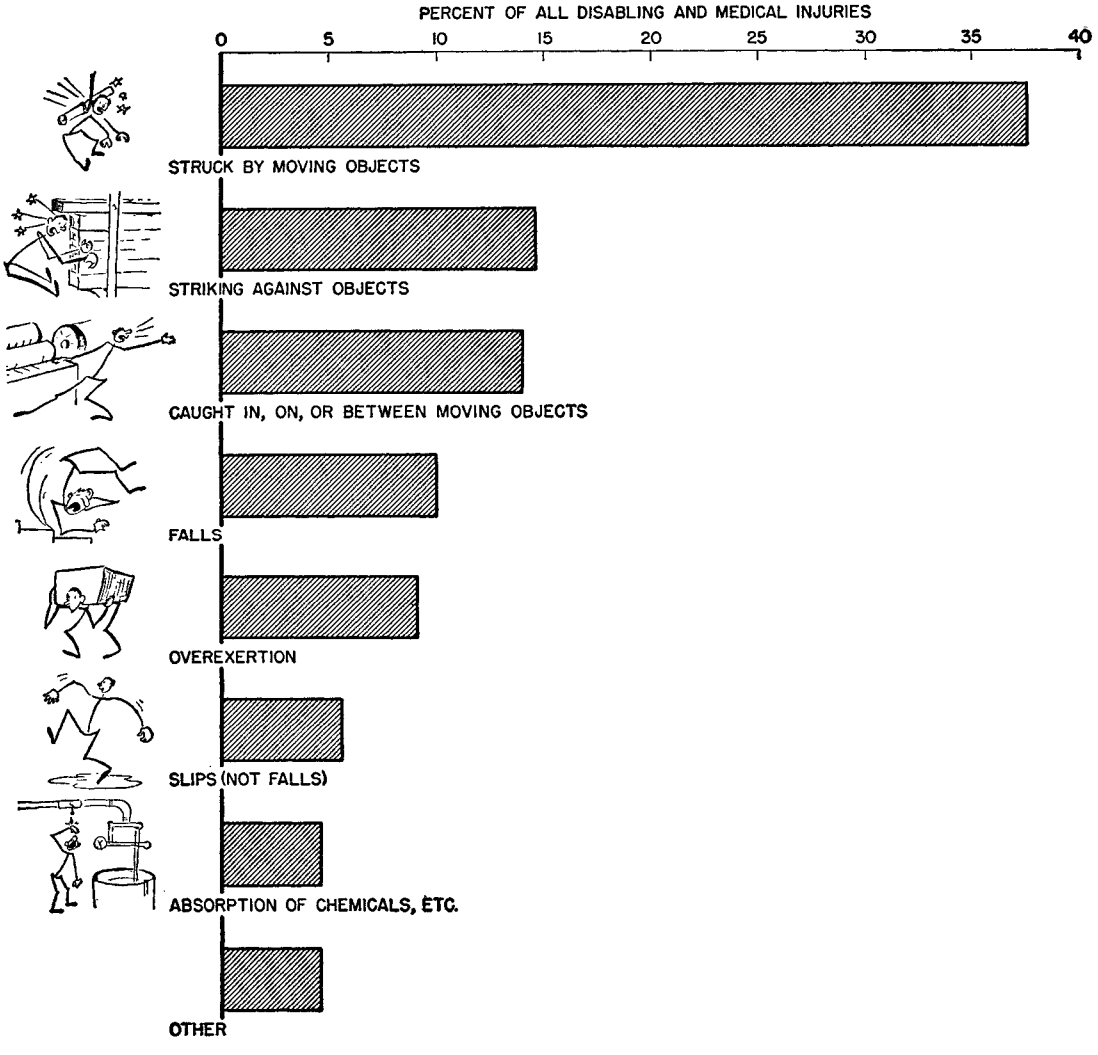
Paper, primarily in rolls or packages, was the agency of injury in nearly 6 percent of the accidents. In more than a third of these cases the injuries were strains or sprains from overexertion in lifting or moving the paper. Most of the others were cases in which the workers were struck by rolls of paper they dropped, or which rolled from hand trucks or other equipment, or in moving caught and pinched them against some other object.

Nearly 5 percent of the reported injuries resulted from sharp and straining movements of the body rather than from contact with any par-

ticular object or substance. These were not the simple overexertion cases resulting from pushing, pulling, or lifting heavy objects—they were practically all cases in which the injured person lost his balance on a slippery surface or stumbled over an object lying in his way and strained himself in his efforts to avoid falling. About half the resulting injuries were back or abdominal strains and most of the others were foot or ankle sprains. The relatively high incidence of this type of accident implies a need for improved housekeeping, particularly pointed to the elimination of slippery and cluttered working surfaces.

Chemicals were the injury-producing agents in over 4 percent of the reported cases. Chemical burns and dermatoses resulting from contact with the cooking liquors were the most common injuries. There were, however, a considerable number of internal injuries resulting from the inhalation of chemical fumes.

CHART 3. MAJOR TYPES OF ACCIDENTS IN THE PULP AND PAPER INDUSTRY, 1948



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Accident Types.—As the analysis of the reported cases moved from injuries to a determination of how the injuries occurred, it became apparent that the most common variety of injury-producing accidents encountered in the pulp and paper industry were those in which the injured persons were struck by moving, falling, or flying objects. Over 37 percent of all the recorded accidents were in this group. Next in numerical importance were the cases in which the workers struck against or bumped into objects. This group, which accounted for over 14 percent of the injuries, however, was nearly equaled by the cases in which the workers were injured by being caught in, on, or between objects. The latter group of accidents produced 14 percent of the injuries. Next in importance, falls were responsible for 10 percent of the injuries; overexertion for 9 percent; and slips or stumbles, which did not culminate in falls, over 5 percent.

About a third of the "struck-by" accidents were cases of flying particles, generally unidentifiable, entering the eyes. The great majority of these flying-particle accidents caused only minor injuries. Much more important, in terms of the seriousness of the resulting injuries, were the cases in which workers were struck by their own hand tools or by other objects which they dropped in handling. Pulpwood logs which were thrown or fell upon workers from piles or from machines, and machine parts which fell or rolled from equipment were also involved in a considerable number of "struck-by" accidents. Accidents in which workers were struck by vehicles were not numerous, but were important because of the relative severity of the resulting injuries. The majority of the vehicular accidents involved hand trucks although there were a number of cases involving powered vehicles.

"Struck-by accidents" were common in all the operating departments. They were, however, of outstanding importance in the woodyards, where they constituted over 55 percent of all recorded accidents. In the wood rooms and ground wood mills about 45 percent of the injuries resulted from "struck-by" accidents.

About half of the "striking-against" accidents were cases in which the workers bumped into plant equipment. The others were primarily cases of striking against projecting nails, or splintered edges on skids, stepping on sharp objects, or bumping into piled materials. The most serious injuries resulted from striking against moving parts of machines.

All the operating departments reported a considerable number of "striking-against" accidents. They were most prominent, however, in the sulfite mills, where they amounted to 21 percent of all recorded accidents, in the paper-machine rooms (over 18 percent), and in the wood rooms (over 17 percent).

The "caught in, on, or between" accidents were particularly important, not only because of their volume but because they frequently caused serious injuries. Nearly half of these accidents resulted from workers being caught in the pinch points of moving machinery, and amputations were frequently necessary. The remainder of the group consisted primarily of accidents in which fingers or toes were crushed under materials being moved manually or in which workers were pinched between moving objects (hand trucks, crane loads, etc.) and other fixed objects. In the paper-machine rooms and in the shipping departments, one out of every five accidents fell into the "caught in, on, or between" category.

Slightly over two-thirds of the reported falls were cases in which the injured person fell only to the surface on which he had been standing. Most of these resulted from slipping or tripping on regular working surfaces. There were, however, many such falls on piled materials and on machines. The falls from elevations included many cases of falls from piled materials, from platforms, and from ladders. Departmentally, falls on the working level occurred most frequently in the beater rooms and shipping departments. Falls from elevations were most common in the sulfite mills, the shipping departments, and the maintenance departments.

The great majority of the "overexertion" accidents occurred in lifting, carrying, pushing, or pulling heavy objects, such as rolls of paper or sticks of pulpwood. In the finishing rooms, one in every six injuries resulted from overexertion. In the beater rooms one in every seven accidents was in this category and in the wet rooms and yard departments the ratio was one in every eight.

About 80 percent of the accidents designated as slips or stumbles (not falls) were cases in which the workers lost their balance because of slipperiness or irregularities in the working surfaces of

their plants. The others were primarily cases of stumbling over materials lying in the workplaces. These accidents were most common in the paper-machine rooms and in the wet rooms.

Accident Causes

Modern accident analysis is based upon two premises: first, that there is an identifiable cause for every accident; and second, that when an accident cause is known, it is usually possible to eliminate or counteract that particular cause as the probable source of future accidents of the same character. In many instances it is true that a variety of circumstances contribute to the occurrence of an accident, and the course accident prevention should take may seem confused because of the multiplicity of the possible avenues of action. It is commonly accepted, however, that every accident may be traced to the existence of some hazardous working condition, to the commission of an unsafe act by some individual, or to a combination of these accident-producing factors.

The sole purpose of accident analysis, as applied to large groups of cases, is to determine what specific factors within each of these two categories of accident causes are most frequently involved in the occurrence of accidents. With this knowledge available, it is then possible to plan a safety program concentrating upon the elimination of these specific accident factors with assurance that success in this objective should quickly lead to a substantial reduction in the volume of injuries.

It must be recognized, however, that accident analysis has definite limitations. At best, it can only furnish clues as to the directions in which accident-prevention activities can most effectively be pointed. What those activities should be and how they are to be carried out must be determined by the individual in control of each safety program after his general objectives have been indicated through accident analysis. It must also be recognized that accident analysis cannot go beyond the reported facts. In other words, the accuracy of any analysis is wholly dependent upon the accuracy and completeness of the original accident reports. In this respect, it has been consistently apparent in the Bureau's surveys that the inadequacies of reporting seriously limit the possibilities of effective analysis. The limitations are not great in broad studies of this type, which bring a sufficient volume of adequate reports into consideration to support an analysis. The shortcomings are specifically at the company or establishment level where the most effective analysis can be performed only when the necessary facts are available.

In general, the inadequacies of most plant-reporting systems stem from the tendency to base accident records upon the legal requirements of the workmen's compensation jurisdiction in which the plant is located. These requirements relate primarily to information about injuries with relatively little emphasis upon how the injury occurred and even less upon why it occurred. These influences were strikingly apparent in the present survey.

Most of the plants included in the survey were those that maintain the most extensive accident records in the industry. All of the 4,170 case records collected were readily classifiable by the nature of the injury experienced, and over 99 percent were readily classifiable by the agency of injury and accident type. The situation was quite different in accounting for the reasons for the occurrence of accidents. Over 44 percent of the case records contained no information on which to base a conclusion concerning the existence or nonexistence of a hazardous condition to which the accidents could be related. Over 65 percent of the case records were similarly deficient in information relating to the commission or noncommission of an unsafe act. Because of the relatively large volume of adequately reported cases yielding significant classification patterns, these deficiencies in accident recording were not serious in this survey. It is evident, however, that they would present serious obstacles to effective analysis at the plant level in many establishments.

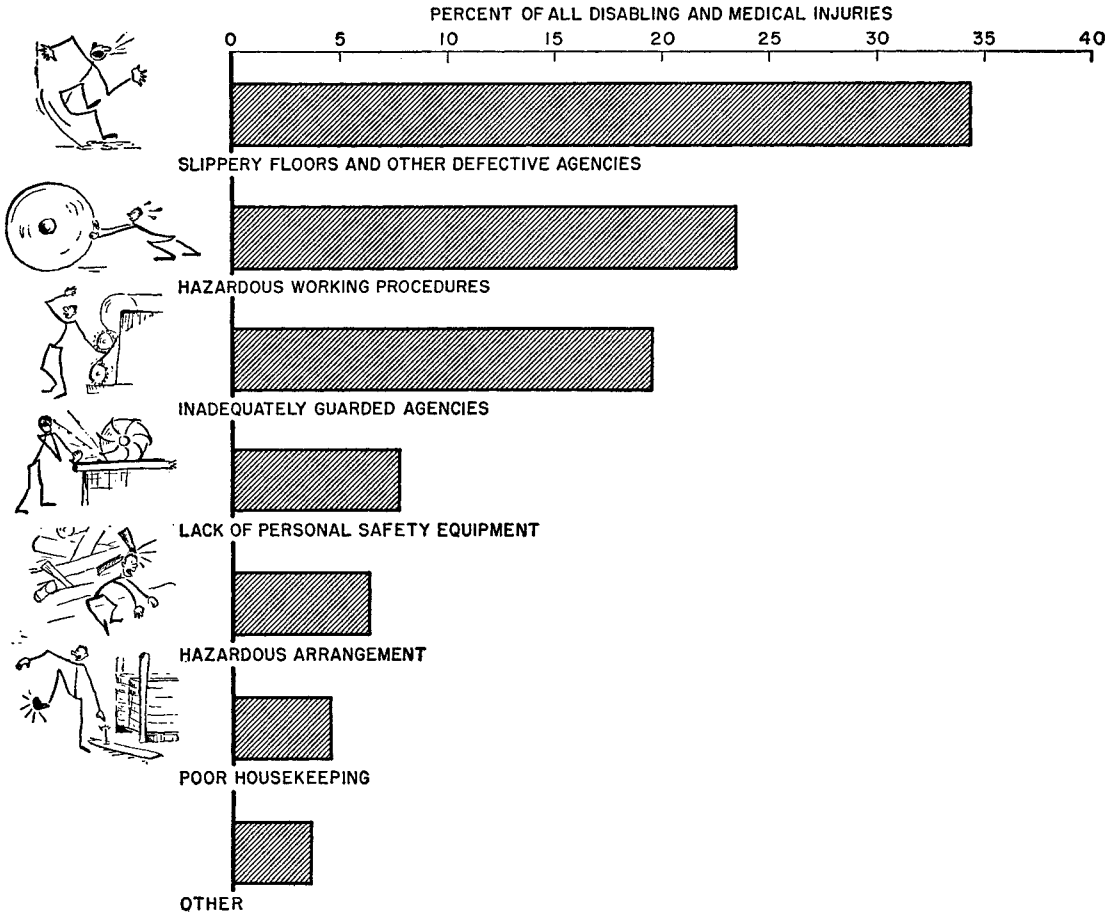
In interpreting the findings relating to hazardous conditions and unsafe acts, it is essential to recognize that these two factors are not necessarily exclusive. In other words, the analysis procedure was not directed toward the determination of a single major cause of each accident, which would have involved an exercise of analytical judgment seldom possible from the available facts. On the contrary, an effort was made to determine inde-

pendently for each accident whether there was a hazardous condition which contributed directly to the occurrence, and whether the event could be directly associated with an unsafe act.

Because many of the reports were inadequate for the determination of one or the other of these factors, it is impossible to draw any conclusion as to whether hazardous conditions or unsafe acts were the leading cause of accidents. For the accident preventionist, however, this is a limitation of little consequence. For his purposes, the pattern of the specific factors within each general category is of more importance than the interrelationship between the major groups of accident causes. This results from the fact that his approach to the elimination of accident causes in the two categories necessarily must be different.

The correction of hazardous working conditions usually is entirely within the powers of management and can be accomplished by direct action. The avoidance of unsafe acts, on the other hand, requires cooperation and understanding by both management and workers. To achieve this understanding, management must take the lead by providing safety-minded supervision and by making sure that all workers are acquainted with the hazards of their operations and are familiar with the means of overcoming them.

CHART 4. MAJOR TYPES OF UNSAFE WORKING CONDITIONS IN THE PULP AND PAPER INDUSTRY, 1948



Hazardous Working Conditions

In broad general groupings, the analysis indicated that the hazardous conditions most commonly leading to accidents in the pulp and paper industry are: defective agencies, which accounted for 34 percent of the accidents; hazardous working procedures, accounting for 23 percent of the accidents; and inadequately guarded agencies, which accounted for 19 percent of the accidents. Of somewhat lesser importance, the lack of personal safety equipment was responsible for nearly 8 percent of the accidents, and the hazardous arrangement of materials and equipment accounted for 6 percent. (See appendix, tables 16, 17, 18.)

Defective Agencies.—Slippery working surfaces, leading to slips and falls, constituted the most common hazard in this general group. No operating department was entirely free of these accidents, but their greatest concentration occurred in the wet rooms, beater rooms, paper-machine rooms, and shipping departments. In the shipping departments many of the slippery surface accidents were attributed to metal dockboards which had been worn smooth. In the operating departments, the slipperiness was most commonly ascribed to water or wet pulp which had spilled or splashed onto the floor.

Sharp-edged or pointed agencies were common sources of severe cuts or abrasions. Projecting nails, wires, or bolts on machines or in dunnage or packing cases, splintered lumber, pallets, or hand tools and projecting nails or splinters on working surfaces were responsible for many injuries of this nature.

Hazardous Working Procedures.—The general practice of manually lifting or moving heavy objects was the cause of more than half the accidents associated with the general group of hazardous working procedures. The bulk of these accidents were cases of overexertion, resulting primarily in strains, sprains, and hernias. There were, however, many cases in which workers dropped materials on their feet or had their fingers, toes, or other body parts pinched by objects which they were moving, simply because those objects were too bulky or too heavy to be manually controlled.

About a third of these overexertion accidents resulted from lifting or moving rolls or bundles of paper. The others occurred mainly in the handling of boxes or crates of supplies, shafts, cores, pulpwood logs, machine parts, and hand trucks. Departmentally, these accidents were most heavily concentrated in the finishing departments, shipping departments, and yard departments.

Working procedures requiring exposure to hot materials, toxic or corrosive chemicals, or flying objects, and working in overly restricted quarters were responsible for over a third of the hazardous procedure accidents. Accidents resulting in chemical burns and dermatoses were the most numerous in this group. Most of these cases involved contact with cooking liquors. The cases of temperature burns also involved primarily contact with cooking liquors. The accidents ascribed to the lack of sufficient working space were primarily cases in which workers struck against their own tools, bumped into objects protruding into the working area, or were struck by tools in the hands of nearby workers. In the chemical pulp mills, the beater rooms, and the yard and shipping departments relatively high proportions of the reported accidents were attributed to these types of hazardous procedures.

Inadequately Guarded Agencies.—In general, the accidents ascribed to inadequate guarding caused injuries of more than average severity. Their importance from the accident-prevention standpoint, therefore, is greater than their number indicated.

Approximately 70 percent of the accidents ascribed to inadequate guarding were cases of inadequate guarding of machines, including conveyors and hoisting equipment. The remainder were primarily related to inadequate guarding of elevated working surfaces, floor openings, and openings into tanks or bins.

In most of the cases associated with machines, other than conveyors and hoisting equipment, the inadequately guarded condition occurred at the point of operation, i. e., at the point where the operator feeds material into the machine. These accident-producing situations included many instances of inadequately guarded nip points, permitting operators to become caught between rollers or under descending parts of machines, and of inadequately covered saws or powered wood-cutting knives, which permitted the operators to come

into contact with the cutting tools. There were also some instances of inadequate guarding of gears, pulleys, and power transmitting chains which resulted in serious injuries. These cases, however, were not particularly common.

Most of the accidents associated with inadequate guarding of conveyors were cases in which the lack of side rails or similar protection permitted materials to fall off the conveyors and strike nearby workers. Situations designated as inadequate in the guarding of working surfaces involved primarily scaffolds or other elevated working surfaces equipped with neither railings to prevent the fall of persons nor toe boards to prevent the fall of materials. There were also a few accidents attributable to unfenced floor, tank, and bin openings.

In the wood rooms 44 percent of the accidents were attributed to inadequate guarding; in the paper-machine rooms the percentage was 30; and in the power departments it was 21. In most of the other operating departments well over 10 percent of the accidents were associated with inadequate guarding.

Lack of Personal Safety Equipment.—The accident records of the pulp and paper industry are replete with cases in which it is obvious that the use of personal protective devices, such as safety shoes, impact goggles, hand leathers, gloves, aprons, or safety helmets, would have prevented or minimized injuries. Wider use of these devices in the industry is unquestionably desirable. In the great majority of cases, however, the use or nonuse of these devices has no bearing upon the occurrence of the accident itself. As accident analysis is primarily concerned with determining the factors which led to the accident, as contrasted to the injury resulting from the accident, the absence of personal protective devices is seldom indicated as a hazardous working condition.

There are, however, certain types of operations involving inherent hazards which can be overcome only through the use of proper protective equipment. Typical of these operations is the use of grinding wheels or other tools or equipment, which constantly throw off particles or chips, and with which the use of impact goggles is essential to avoid eye injuries. Similarly, it is generally accepted that the use of goggles, gloves, and other protective clothing is an essential part of the operations involved in mixing or handling caustics or other hazardous chemicals.

Most of the accidents ascribed to the lack of personal safety equipment in this analysis occurred in operations of the types described above. In two-thirds of the cases the deficiency was a lack of goggles. In most of the other cases it was the lack of gloves, rubber aprons, or other protective clothing required in the handling of corrosive chemicals. Nearly 65 percent of these accidents, occurred in the maintenance departments.

Hazardous Arrangements.—The hazardous arrangements identified in this analysis are closely related to the conditions normally designated as poor housekeeping, but because they represent relatively permanent situations, they were treated separately.

Improperly piled materials falling onto the workers, and improperly placed materials obstructing working areas or creating tripping hazards, constituted the most important hazards in this group. Pulpwood logs were the objects most commonly piled in hazardous fashion.

Unsafe Acts

For the purpose of this analysis, an unsafe act was defined as that violation of a commonly accepted safe procedure occasioning or permitting the occurrence of the injury-producing accident. Literally, this definition means that no personal action should be designated as unsafe unless there is a reasonable and less hazardous alternative procedure. For example, the use of an unguarded machine for which no guard was provided was classified as a hazardous condition, but not as an unsafe act. On the other hand, the failure to wear goggles on an eye-hazardous operation when such goggles had been provided was classified as an unsafe act because in this instance there was a less-hazardous alternative procedure.

The analysis, however, does not imply that the alternative safe procedure was known to the person acting in an unsafe manner, nor that his unsafe act was the result of a considered choice between two possible procedures. It was apparent in many of the accidents studied in this survey that the individual knew the safe procedure, but consciously decided not to follow it. In other cases,

circumstances indicated that the person acted unsafely simply because he did not know the alternative safe method. The first step toward the elimination of unsafe acts, therefore, is to make sure that all workers are thoroughly instructed in the safe methods of performing their duties and that they are familiar with the hazards connected with deviations from them. The second essential step is to exercise strict supervision to see that safe procedures are followed.

Of the accidents attributed to unsafe acts in this survey, 48 percent resulted from unsafe handling or unsafe use of equipment; 24 percent from assuming an unsafe position or posture; 7 percent from unsafe placing or loading; 6 percent from failing to secure or warn; and 5 percent from failure to wear safety equipment or safe clothing. (See appendix, table 19.)

Unsafe Handling or Unsafe Use of Equipment.—The outstanding unsafe act in this general group was that of misapplying or wielding hand tools in such manner as to cause the tool to strike the operator or one of his coworkers. Pulphooks were the tools most commonly involved in these accidents, although there were many cases involving other hand tools, such as hammers and wrenches. The group also included numerous accidents resulting from the use of hand tools or other equipment for purposes other than that for which intended.

The unsafe acts associated with manual handling of materials consisted primarily of gripping objects insecurely or of taking the wrong hold on objects. The accidents resulting from gripping objects insecurely most commonly were cases where the workers dropped objects on their feet. In many instances the fault lay in attempting to lift too many objects at one time or in using one hand instead of two. In other instances workers attempted to lift irregular, slippery, or hot objects by grasping only a small section and found it impossible to hold them because they were unbalanced.

Taking the wrong hold on objects was responsible for many crushed fingers and hands. In most of these accidents the workers' fingers or hands were pinched or crushed under or between objects they were placing or piling.

Unsafe Position or Posture.—Nearly two-thirds of the unsafe acts in this group consisted simply of inattention to footing or surroundings. Failure to observe normal caution in ascending or descending ladders or stairways, or in merely walking across floors or yards was the most common fault. Poor housekeeping was a contributing factor to some accidents in which workers slipped or stumbled over small objects on the floor. Most commonly, however, the accidents consisted simply of the workers walking into or bumping against machines, pipes, piled materials, and other objects which should have been quite visible and avoidable.

The most serious accidents in this group were those resulting from workers unnecessarily exposing themselves to contact with moving or falling objects. These cases included such actions as walking or standing too close to the moving parts of machines when not actually working on the machines, standing under or in the line of movement of crane loads, approaching the bottom of pulpwood piles while they were being broken down, and walking or standing in front of moving vehicles.

Unsafe Placing or Loading.—The most common unsafe act in this group was placing of materials in insecure piles, or placing them in such fashion that they fell onto the worker. The unsafe-piling accidents usually were cases of material falling from the piles onto the workers, but there were some instances in which improperly piled materials shifted or tipped, causing workers on top of the piles to fall.

In addition, there were some accidents ascribed to the parking of vehicles or the placing of materials in the workplace in such manner as to create obstructions or tripping hazards.

Failure to Secure or Warn.—A wide variety of unsafe acts fell into this group. Under the general heading of failure to secure or block there were a number of cases in which machine parts were set in place but were not firmly screwed down or otherwise attached so that they came loose later and fell on the operators. Hand trucks and other vehicles were sometimes parked on grades without being properly braked or blocked to prevent their running away. In other instances maintenance men and machine operators were injured while

cleaning or adjusting machines because they had neglected to tag or lock the control switches to prevent the equipment from being started.

The unsafe acts classified as "failure to warn" were primarily cases in which machinery was started without notice to other workers who were working on or close to the equipment. There were also a number of cases in which workers threw materials from vehicles or piles without warning others below to stand clear.

Failure To Wear Personal Safety Equipment or Proper Clothing.—More than half the unsafe acts included in this group consisted of failure to wear goggles which had been provided for use in operations presenting extensive eye hazards. The others consisted primarily of failure to wear gloves, aprons, or face masks provided for use when working with hazardous chemicals, and of wearing loose clothing, particularly loose sleeves and neckties, while working on moving machinery.

Accident Prevention Suggestions

To illustrate the general types of accident problems in the pulp and paper industry, a number of typical accidents were selected for detailed study. These accidents were analyzed by a member of the Division of Safety Standards of the Bureau of Labor Standards of the United States Department of Labor and suggestions were made to indicate how these accidents might have been prevented.

The purpose of this portion of the report is not to make all-inclusive recommendations, nor to propound authoritative safety rules for the industry, but to point out that there is a simple approach to the prevention of nearly every type of accident. Many safety engineers, no doubt, would attack the problems involved in these accidents in different ways and would achieve equally good results. The method of prevention, however, is of secondary importance as long as it accomplishes its purpose.

Brief descriptions of the selected accidents accompanied by the recommendations of the Bureau of Labor Standards' safety specialist for the prevention of such accidents are given on the following pages.

Case Descriptions and Recommendations

1. An employee was hauling bundles of newspaper from a boxcar at night. In the dark, he misjudged his distance and one wheel of the truck missed the plate. The truck jerked, causing him to strain his shoulder.

This is an obvious case of inadequate yard lighting.

2. An employee was unloading lime from a railroad car. Lime dust mixed with prespiration, resulted in burns on the employee's ankles.

Workers who handle or mix lime should wear clothing which will cover as much of the body as possible (long sleeves, boots, gloves, goggles, etc.) to minimize contact with the lime.

3. A jammer (crane with grapple bucket) was being used to unload pulpwood logs from a gondola car. When the operator opened the bucket, a log fell and struck an employee working on the pile of logs.

The usual precaution of not permitting men to work under a suspended load was not customarily observed in this plant and the inevitable happened. Men should never be permitted to work under a suspended load, particularly when the load is carried by a grapple bucket. Logs often fall from the bucket even when the bucket is not opened.

4. An employee was helping to carry a large log. When his co-workers dropped the log, a knot in the log scraped the employee's chest.

Men doing work of this sort should be carefully trained in safe lifting and carrying methods. This is particularly true for a two or more, man carry. Left to themselves, few men will develop safe methods of lifting.

5. While unloading wood from a railroad car, an employee dropped a log on his foot. The log was slippery owing to snow and ice.

Logs were being unloaded by hand and hazards caused by ice and snow are difficult to control. A

mechanical means of unloading logs is probably the best way to control accidents of this type.

Safety shoes might have avoided or minimized the injury.

6. A wood handler was moving logs with a picaroon from a pile onto a conveyor. His picaroon slipped from a log and struck his foot.

Investigation revealed that the picaroon was not sharp. Picaroon points should be kept sharp at all times so that the point can easily penetrate the log.

7. An employee was unloading pulpwood from a railroad car. When he attempted to throw a log from the car, it struck the side of the car, fell back and struck him on the foot.

The fact that pulpwood was being thrown from the car indicates a basic error in handling material. Material as bulky and heavy as pulpwood should not be handled in such a way that the employee would be required to lift it over the side of the car.

Safety shoes might have avoided or minimized the injury.

8. While unloading logs from a railroad car, an employee tripped in a hole in the floor, lost his balance, and dropped a stick of pulpwood on his foot.

Investigation shows that the car was a boxcar owned by a common carrier. The car, of course, should have been repaired by the railroad. This was not done. The employee unloading the car should have made temporary repairs by covering the hole. Safety shoes might have avoided or minimized the injury.

9. While unloading pulpwood, an employee was injured when a splinter from a log punctured his finger.

When handling pulpwood logs, gloves or other type of hand protection should be used.

10. An employee was using a picaroon to move pulpwood logs. When the point of the picaroon snapped off, the employee lost his balance and fell on the log.

Investigation disclosed that the picaroon had been badly bent. In restraightening, it was heated and then reforged. In annealing after bending and sharpening, it became brittle and the point broke off. Annealing should never be done except by an expert. In this case annealing was not expertly done.

11. As an employee was walking past a pile of stored pulpwood, one log slid from the pile, and struck and fractured his leg.

Regular walkways adjacent to piled materials which may slide or roll should be protected by a barrier guard or should be elevated so that sliding materials may pass under the walking surface.

12. An employee was wearing gloves while drilling knots from pulpwood. When the gloves caught in the drill his finger was pulled against the bit.

Gloves should never be worn when operating a drill.

13. An employee was placing wood in the chipper. A chip flew from the machine and struck his eye.

A screen should have been provided which would protect the operator against flying chips. Individual eye protection, either goggles or a face shield, should also have been provided.

14. An employee was barking logs with a hand barker. As he was pushing a stick of pulpwood against the knives, the log slipped and his hand struck the knives.

Hand barking of logs is always dangerous. A mechanical feed and turn-over device is usually practicable to eliminate the need for the operator to feed the logs against the knives by hand.

15. An employee was using an axe to remove pieces of bark remaining on logs after they had passed through the barking drum. His axe struck a knot, glanced from the log, and hit his leg.

A high injury rate is characteristic of axe work unless the men are trained in the safe use of the axe. Through training, however, such injuries can be eliminated. The grip, the stance, the swing, and the return must all be correct and properly coordinated.

16. An employee was wearing gloves while using a disc-type barker. A knot on a log caught his glove and pulled his hand into the barker.

This appears to be another instance where the wearing of gloves created a hazard in a particular operation. Hand protectors, if needed, should be of a type that will pull free if caught.

17. An employee was using a bar to free logs in the chipper. When a second worker threw a log into the chipper, it struck the bar, causing the bar to strike the injured employee's head.

Chippers are hazardous machines. Safe operating methods should be developed and the operators carefully trained to follow them. In this case the chipper should have been shut down in order to free it.

18. The employee was pulling logs out of a conveyor. His pulp hook slipped from a log and the log fell on his foot.

Investigation of this accident showed that the pulp hook was dull. Pulphooks should be kept sharp so that the point can penetrate the log. Safety shoes might have avoided or minimized the injury.

19. An employee was cleaning under the chip conveyor. The belt caught his broom and pulled his hand between the belt and roller.

If the guarding is not adequate to prevent contact with the belt, the conveyor should be shut down while cleaning around it.

20. A rag cooker was making a bleach by mixing chlorine gas, lime, and water. Despite the fact that he was wearing a canister mask approved for chlorine protection, he inhaled some of the gas. On investigation, it was found that the canister had been in use longer than recommended by the manufacturer.

The effective life of a canister is definitely limited and the manufacturer's recommendations for replacement should be followed strictly. For this purpose an accurate record should be maintained for each canister showing both its age and the time it has been worn. A regular checking procedure should be developed and maintained to insure that replacements are made within the specified time limits.

21. Workers on one shift completed the charging of a digester and left it for the next shift, presumably ready for the "cook." However, they neglected to close the valve on the acid line leading into the digester, although they had closed the main acid-line valve. As the digester was brought to cooking pressure, the charge backed up into the acid line. When the acid feed line to a second digester was opened during the charging operation, the pressure on the line caused a blow-out of chips, acid, and gas. An employee was severely burned.

Obviously the workers on the first shift should have closed the feedline valve. The second-shift supervisor, however, should have checked the equipment before putting it into operation to make sure that everything was in proper condition. Such a check should be a standard procedure in connection with the operation of any pressure vessel. A type of valve with a high-rising spindle which readily shows whether the valve is open or closed facilitates inspection.

22. An employee entered the bleach house to shut off the chlorine line and inhaled chlorine gas escaping from a leaking flange.

In this case the line was being shut off to permit repair of the leaking flange. It was known, therefore, that gas was escaping and the employee should have worn a suitable gas mask.

23. An employee was holding a two-wheeled truck onto which a frozen bale of pulp was being tipped. As the bale fell onto the truck, the truck jerked, straining employee's shoulder.

Handling two-wheeled trucks is hazardous, particularly if the objects handled are bulky and heavy. On all such work, safe methods suited to the conditions involved should be worked out and all the men thoroughly trained in their use. In this case the basic rule calling for the handled object to be always kept under control was violated.

24. An employee was opening a valve on the leacher with a pipe wrench. The pipe he was using for additional leverage slipped off the wrench, causing the employee to fall.

The employee had placed a 2-foot section of pipe over the wrench handle to get additional leverage. Extending the wrench handle is always dangerous and only a type of extension which can be securely locked into the handle should be used.

25. While an employee was mixing lime in a mixing bin, some lime splashed in his eye.

Workers who handle or mix lime should wear clothing that covers as much of the body as possible

(long sleeves, boots, gloves, etc.) in order to minimize contact with the lime. Tight-fitting goggles are essential for eye protection in this operation.

26. An employee was standing in a broke cart pulling broke from a chute. Because of insufficient head room, he had to work in a half-standing, half-squatting position. He strained his abdomen.

The broke chute should never discharge into a location with head room insufficient for the employee to stand erect.

27. While pushing broke into the broke hole, an employee lost his balance and fell into the pit.

In some plants a railing is placed around the broke hole to prevent accidents of this kind.

28. While walking across a wet floor, an employee slipped and fell, striking his head against a paper machine.

Adequate drainage facilities will go a long way toward eliminating slipperiness owing to wet floors. Rubber soled shoes would also help to prevent falls. When floors are laid or resurfaced, a high-friction floor surface sloping gently to drainage channels can be provided.

29. While an employee was setting slitters, the shaft rolled off the saw-horses and struck him on the foot.

The shaft should have been securely blocked. Some shops use special horses which hold the shafts securely yet permit them to be easily turned over by hand.

30. An employee attempted to thread paper through the dryer rolls by hand. His hand was caught and pulled between the rolls.

Feeding paper into rolls is always dangerous. A blast of air on a feeder belt would eliminate the necessity of getting close to the rolls. When a mechanical device cannot be used, a rounded stick is sometimes used or the paper is thrown into the pinch point.

31. As an employee attempted to pick up a 200-pound roll of paper, he strained his back.

No one should attempt to lift a 200-pound roll of paper. Either a mechanical lifting device should be used, or the employee should get help. All who must lift heavy objects should be trained in safe lifting methods.

32. An employee was wiping moisture from a V-belt to prevent it from slipping. His fingers were caught by the belt and pulled into the pulley.

A belt compound which would prevent slipping should be used instead of attempting to wipe away the moisture. Pulleys should be guarded.

33. Some excess grease fell to the floor as an employee was wiping the bearings of a machine. Later, he slipped in the grease and grabbed a hot condensate line to keep from falling. He burned his hand.

A catch pail of some kind should be installed under the bearing so that grease could not drip on the floor. In this instance the grease should have been cleaned up immediately.

34. An employee was applying a stick dressing to a belt at the in-running side of a pulley. The stick adhered to the belt and pulled the employee's hand into the pulley.

When a stick dressing is applied, it should be done at the out-running side of the pulley. The in-running side of pulleys should be guarded.

35. An employee was trucking pulp to the beater. When a wheel of his truck hit a hole in the concrete floor, the truck jerked, straining the employee's back.

Poor housekeeping is indicated. The hole in the concrete floor should have been repaired as soon as it was noticed.

36. An employee was cutting a metal strap from a bale of pulp. As it was severed, the strap flew back, striking the employee's eyes.

This operation should be performed by standing to the left of the cut, holding the band with the left hand and the cutter with the right. The free end of the band will then move away from the worker when it is cut.

Even when performed with the greatest care, this is a hazardous operation. The possibility of experiencing serious eye injuries or severe face cuts dictates that face shields, or goggles as a minimum, should always be worn on this work.

37. While loading rolls of paper into a railroad car, an employee was injured when the steel loading platform to the car slipped and fell between the car and the loading dock.

Car-loading platforms should be so designed that they cannot slip out of place during the loading operation.

38. An employee attempted to walk across a steel plate into a boxcar. The plate was worn and slippery owing to extended use. The employee slipped and fell between the car and the loading platform.

Car-loading plates should be of material that does not readily wear smooth, or the surface should be periodically roughened to prevent slipperiness.

39. While an employee was loading a boxcar, a locomotive bumped the car, throwing the worker to the floor of the car.

Warning signs should have been placed on the spur track to warn the locomotive engineer that the car was in use.

40. While a maintenance worker was repairing a paper machine, another employee was cleaning it with an air hose. Some foreign particles entered the maintenance worker's eye.

Extreme care must be used when using an air hose for any purpose, particularly in cleaning where dust or dirt may be blown toward another worker.

41. A pipe fitter was standing on a pipe repairing a leak in a 6-inch steam line in the caustic room. When his foot slipped off the pipe, he stepped into the hot water from the steam and burned his foot.

Pipes are for the purpose of transporting material and not to stand on. A secure footing for the pipe fitters would have avoided this accident.

42. An employee left a 25-pound wrench on a nut which he had just tightened. Later, as he walked by, he knocked the wrench from the nut. The wrench fell on his foot.

After a wrench is used, it should always be removed from the nut and returned to the tool box or work bench.

43. Some chips lodged in the eye of a welder who was knocking hot slag from his weld.

Investigation disclosed that this man was doing electric welding, his eyes being protected by a welder's helmet. He raised the helmet to knock off the slag and a piece of the slag penetrated the eye. No goggles were worn under the helmet; if they had been worn this injury would have been avoided.

44. As a carpenter was using a circular saw, a board he was cutting kicked back and struck him on the chest.

Investigation disclosed the saw to have been equipped with a hood but not with kick-back dogs or a spreader. The board was warped and kicked back when forced through the saw. A spreader would have prevented the accident; kick-back dogs on the saw guard would probably have prevented it.

45. Liquor in the pipe of an evaporator sprayed the face of a pipe fitter, as he was removing a valve.

Employees working with pipe lines carrying steam, hot liquids, or hazardous chemicals should be provided with, and be required to wear, tight-fitting goggles or face shields. Full face protection is usually preferable.

46. A machinist was turning a piece of metal on a lathe. A small particle flew from the lathe and lodged in his eye.

This type of work obviously calls for eye protection. Face shields are often preferred to goggles.

47. An employee carrying an angle iron up a ladder, lost his balance and fell, straining his side.

The angle iron weighed about 35 pounds. Instead of being carried up the ladder, it should have been hauled up with a rope.

48. A stick of pulpwood fell from a conveyor while a janitor was cleaning under it, and struck him on the head.

If work of any kind is permitted under an open conveyor, a shield guard should be placed under the conveyor to catch materials falling from it.

49. A painter was burned by the current in noninsulated wires, when his steel-banded brush touched them.

No work should be performed within contact distance of noninsulated wires until they have been deenergized. Arrangements should have been made to lock the switch in open position and the key given to the painter so that no one else could close the switch while he was working around the wires.

50. A mason was working in the blow pit of a digester. The digester was not operating and the acid line feeding into it had been closed, but the discharge line leading from the digester had been left open. Someone opened the acid line and allowed some acid to flow into the digester. Fumes from the acid seeped into the pit through the open discharge line and the mason was overcome.

Both the acid line and the discharge line should have been locked shut, or a guard posted before the mason was permitted to enter the pit. This should be the responsibility of the operating supervisor in charge of the equipment. Masons and other service or maintenance workers, however, should be required to notify the operating supervisor whenever they are going to work on or about the equipment and to ask that any necessary precautions be taken.

51. A small particle of concrete lodged in the eye of a foreman watching jackhammer workers break a concrete floor.

The injured foreman was from another department and should not have been there. This is a good illustration of the necessity for wearing goggles around any operation where there is a flying particle hazard, whether or not actually working in the area.

Appendix.—Statistical Tables

TABLE 1.—Work-injury rates for 534 pulp and paper mills, classified by type of mill and by extent of disability, 1948

Type of mill	Number of establishments	Number of employees	Employee-hours worked (thousands)	Number of disabling injuries				Frequency rates of [2]—				Severity		
				Total	Resulting in—			All disabling injuries	Deaths and permanent-total disabilities	Permanent-partial disabilities	Temporary-total disabilities	Average number of days lost or charged per—		Severity rate [3]
					Death or permanent-total disability [1]	Permanent-partial disability	Temporary-total disability					Disabling injury	Temporary-total disability	
Total [4]	534	207,309	454,207	9,012	(10) 55	510	8,447	19.8	0.1	1.1	18.6	123	18	2.4
Paper mills :														
Absorbent paper	8	659	1,417	51			51	36.0			36.0	16	16	.6
Book paper	31	29,609	65,639	1,110		49	1,061	16.9		.7	16.2	71	17	1.2
Building paper	41	12,296	26,625	315	4	29	282	11.8	.2	1.1	10.5	215	24	2.5
Coarse paper	43	29,838	64,271	1,073	8	79	986	16.7	.1	1.2	15.4	163	25	2.7
Fine paper	72	22,935	50,856	1,026	(1) 2	42	982	20.2	[5]	.8	19.4	85	16	1.7
Groundwood paper	11	3,731	8,320	219	1	10	208	26.3	.1	1.2	25.0	112	19	3.0
Newsprint	6	3,470	7,917	293		5	288	37.0		.6	36.4	30	18	1.1
Sanitary paper stock	24	4,884	9,807	243	2	19	222	24.8	.2	1.9	22.7	156	15	3.9
Special industrial paper	6	1,197	2,481	44	1		43	17.7	.4		17.3	152	16	2.7
Tissue paper	39	12,019	25,844	510	1	30	479	19.7	[5]	1.2	18.5	95	13	1.9
Paperboard mills :														
Building board	15	6,536	14,841	259	(1) 1	27	231	17.5	.1	1.8	15.6	213	15	3.7
Container and boxboard	85	33,796	72,722	1,713	(6) 20	79	1,614	23.6	.3	1.1	22.2	137	15	3.2
Special paperboard stock	10	2,988	6,533	89		25	64	13.6		3.8	9.8	296	12	4.0
Wet machine board	12	619	1,366	47	2	2	43	34.4	1.5	1.5	31.4	280	13	9.6
Pulp mills	14	2,058	4,748	127	2	7	118	26.7	.4	1.5	24.8	175	24	4.7

[1] Figures in parentheses indicate the number of permanent-total disability cases included.

[2] The frequency rate is the average number of disabling injuries per million hours worked. A disabling work injury is one which results in (a) death, or (b) any degree of permanent physical impairment, or (c) renders the injured unable to work at any regularly established job open and available to him, throughout the hours corresponding to his regular shift on any day after the day of injury.

[3] The severity rate is the average number of days lost per thousand hours worked.

[4] Totals include figures not shown separately because of insufficient data.

[5] Less than 0.05.

TABLE 2.—Work-injury rates for 534 pulp and paper mills, classified by geographic area, State, type of mill, and extent of disability, 1948

Geographic area, State, and type of mill	Number of establishments	Number of employees	Employee-hours worked (thousands)	Number of disabling injuries				Frequency rates of [2]—				Severity		
				Total	Resulting in—			All disabling injuries	Deaths and permanent-total disabilities	Permanent-partial disabilities	Temporary-total disabilities	Average number of days lost or charged per—		Severity rate [3]
					Death or permanent-total disability [1]	Permanent-partial disability	Temporary-total disability					Disabling injury	Temporary-total disability	
Total, all areas	534	207,309	454,207	9,012	(10) 55	510	8,447	19.8	0.1	1.1	18.6	123	18	2.4
New England area: Total [4]	**119**	**34,828**	**77,782**	**2,115**	**6**	**45**	**2,064**	**27.2**	**.1**	**.6**	**26.5**	**53**	**16**	**1.4**
Paper mills :														
Book paper	4	5,622	13,011	377		5	372	29.0		.4	28.6	26	13	.8
Coarse paper	5	923	2,339	53		1	52	22.7		.4	22.3	27	22	.6
Fine paper	25	6,233	13,040	305		4	301	23.4		.3	23.1	24	15	.6
Groundwood paper	3	1,273	2,804	95	1	2	92	33.9	.4	.7	32.8	118	16	4.0
Newsprint	3	2,009	4,596	223		1	222	48.5		.2	48.3	23	20	1.1
Tissue paper	9	1,491	3,329	213		4	209	64.0		1.2	62.8	29	10	1.9
Paperboard mills :														
Container and boxboard	6	1,411	2,876	111		2	109	38.6		.7	37.9	42	16	1.6
Special paperboard stock	4	882	1,955	28		1	27	14.3		.5	13.8	22	12	.3
Pulp mills	5	989	2,353	40	1	3	36	17.0	.4	1.3	15.3	256	17	4.3
Connecticut : Total [4]	15	3,335	7,059	237	1	12	224	33.6	.1	1.7	31.8	87	16	2.9
Paperboard mills :														
Container and box board	3	1,181	2,386	89		1	88	37.3		.4	36.9	33	13	1.2
Maine : Total [4]	23	15,924	36,703	967	2	22	943	26.3	.1	.6	25.6	51	15	1.3
Paper mills :														
Book paper	3	5,292	12,338	366		5	361	29.7		.4	29.3	27	13	.8
Fine paper	4	2,348	5,254	120		4	116	22.8		.8	22.0	36	12	.8
Newsprint	3	2,009	4,596	223		1	222	48.5		.2	48.3	23	20	1.1
Pulp mills	5	989	2,353	40	1	3	36	17.0	.4	1.3	15.3	256	17	4.3
Massachusetts : Total [4]	54	9,926	21,453	613	1	4	608	28.6	(5)	.2	28.4	31	17	.9
Paper mills :														
Fine paper	21	3,885	7,786	185			185	23.8			23.8	17	17	.4
Tissue paper	4	551	1,254	106			106	84.5			84.5	7	7	.6
New Hampshire : Total	19	3,912	8,182	165	2	4	159	20.2	.2	.5	19.5	123	17	2.5
Vermont : Total	7	1,479	3,711	115		3	112	31.0		.8	30.2	30	16	.9
Middle Atlantic area: Total [4]	**147**	**39,220**	**86,803**	**1,853**	**(2)10**	**150**	**1,693**	**21.3**	**.1**	**1.7**	**19.5**	**162**	**18**	**3.5**
Paper mills :														
Book paper	8	6,077	13,231	220		19	201	16.6		1.4	15.2	122	16	2.0
Coarse paper	8	2,946	6,236	91		9	82	14.6		1.4	13.2	138	25	2.0
Fine paper	16	6,469	14,720	260		15	245	17.7		1.0	16.7	109	20	1.9
Sanitary paper stock	14	1,631	3,538	104	1	13	90	29.4	.3	3.7	25.4	271	17	8.0
Special industrial paper	3	929	1,867	36	1		35	19.3	.5		18.8	182	16	3.5
Tissue paper	19	3,623	8,201	144	1	16	127	17.6	.1	2.0	15.5	250	14	4.4
Paperboard mills :														
Building board	4	590	1,291	30		3	27	23.2		2.3	20.9	221	12	5.1
Container and boxboard	20	4,409	9,844	323	(1) 3	24	296	32.8	.3	2.4	30.1	184	14	6.0
Pulp mills	3	512	1,192	41			41	34.4			34.4	25	25	.9
New Jersey : Total [4]	25	6,271	13,580	291	2	32	257	21.4	.1	2.4	18.9	225	20	4.8
Paper mills :														
Fine paper	3	622	1,265	46		1	45	36.4		.8	35.6	80	15	2.9
Paperboard mills :														
Container and boxboard	3	1,016	2,191	113	1	14	98	51.6	.5	6.4	44.7	268	14	13.8
New York : Total [4]	80	20,984	47,155	1,075	(1) 5	106	964	22.8	.1	2.2	20.5	177	18	4.0
Paper mills :														
Book paper	5	4,429	9,735	174		18	156	17.9		1.8	16.1	138	15	2.5
Coarse paper	6	1,651	3,286	68		6	62	20.7		1.8	18.9	117	17	2.4
Fine paper	6	2,262	5,460	80		12	68	14.7		2.2	12.5	220	21	3.2
Sanitary paper stock	11	1,324	2,890	65		10	55	22.5		3.5	19.0	274	18	6.2
Tissue paper	11	1,445	3,555	117	1	14	102	32.9	.3	3.9	28.7	250	13	8.2
Paperboard mills :														
Container and boxboard	10	2,804	6,137	142	(1) 2	9	131	23.1	.3	1.5	21.3	197	15	4.5
Pulp mills	3	512	1,192	41			41	34.4			34.4	25	25	.9

See footnotes at end of table.

TABLE 2.—Work-injury rates for 534 pulp and paper mills, classified by geographic area, State, type of mill, and extent of disability, 1948—Continued

Geographic area, State, and type of mill	Number of establishments	Number of employees	Employee-hours worked (thousands)	Number of disabling injuries				Frequency rates of [2]—				Severity		
				Total	Resulting in—			All disabling injuries	Deaths and permanent-total disabilities	Permanent-partial disabilities	Temporary-total disabilities	Average number of days lost or charged per—		Severity rate [3]
					Death or permanent-total disability [1]	Permanent-partial disability	Temporary-total disability					Disabling injury	Temporary-total disability	
Pennsylvania: Total [4]	42	11,965	26,067	487	(1) 3	12	472	18.7	.1	.5	18.1	90	17	1.7
Paper mills:														
Book paper	3	1,648	3,496	46		1	45	13.2		.3	12.9	61	22	.8
Building paper	3	710	1,521	19			19	12.5			12.5	13	13	.2
Fine paper	7	3,585	7,994	134		2	132	16.8		.3	16.5	53	21	.9
Tissue paper	5	2,050	4,369	27		2	25	6.2		.5	5.7	253	17	1.6
Paperboard mills:														
Container and boxboard	7	589	1,516	68		1	67	44.9		.7	44.2	18	14	.8
East North Central area: Total [4]	**146**	**57,805**	**126,942**	**2,429**	**(1) 14**	**97**	**2,318**	**19.1**	**.1**	**.8**	**18.2**	**96**	**16**	**1.8**
Paper mills:														
Book paper	13	9,275	21,200	361		12	349	17.0		.6	16.4	62	18	1.0
Coarse paper	10	2,780	5,948	152	1	7	144	25.6	.2	1.2	24.2	137	14	3.5
Fine paper	27	8,103	18,446	425	1	15	409	23.0	.1	.8	22.1	71	14	1.6
Sanitary paper stock	6	2,741	5,224	96	1	5	90	18.4	.2	1.0	17.2	92	15	1.7
Tissue paper	8	5,828	11,786	118		5	113	10.0		.4	9.6	29	17	.3
Paperboard mills:														
Container and boxboard	32	15,463	34,455	784	6	22	756	22.8	.2	.6	22.0	78	13	1.8
Illinois: Total [4]	16	3,839	8,483	173	2	8	163	20.4	.2	.9	19.3	145	15	3.0
Paper mills:														
Building paper	8	1,508	3,178	39	1	3	35	12.3	.3	.9	11.0	308	15	3.8
Paperboard mills:														
Container and boxboard	4	1,526	3,417	102		3	99	29.8		.9	28.9	24	15	.7
Indiana: Total [4]	9	1,175	2,595	80		2	78	30.8		.8	30.0	113	13	3.5
Paperboard mills:														
Container and boxboard	5	574	1,258	52			52	41.3			41.3	10	10	.4
Michigan: Total [4]	36	15,849	35,739	848	3	24	821	23.7	.1	.7	22.9	63	14	1.5
Paper mills:														
Book paper	4	2,681	6,105	106			106	17.4			17.4	14	14	.2
Fine paper	9	2,736	6,669	214		5	209	32.1		.7	31.4	28	13	.9
Paperboard mills:														
Container and boxboard	11	8,052	17,775	386	3	6	377	21.7	.2	.3	21.2	65	13	1.4
Ohio: Total [4]	40	13,187	29,672	551	(1) 5	26	520	18.6	.2	.9	17.5	114	18	2.1
Paper mills:														
Coarse paper	4	483	1,083	28	1	3	24	25.9	.9	2.8	22.2	265	13	6.9
Fine paper	4	590	1,326	58		2	56	43.7		1.5	42.2	75	15	3.3
Paperboard mills:														
Container and boxboard	11	4,318	9,786	207	2	11	194	21.2	.2	1.1	19.9	104	13	2.2
Wisconsin: Total [4]	45	23,755	50,454	777	4	37	736	15.4	.1	.7	14.6	107	17	1.7
Paper mills:														
Book paper	7	5,804	13,194	183		11	172	13.9		.8	13.1	104	19	1.4
Coarse paper	3	1,123	2,350	88		1	87	37.5		.4	37.1	20	13	.7
Fine paper	13	4,663	10,185	145	1	7	137	14.2	.1	.7	13.4	127	16	1.8
Sanitary paper stock	6	2,741	5,224	96	1	5	90	18.4	.2	1.0	17.2	92	15	1.7
Tissue paper	5	5,369	10,705	93		5	88	8.7		.5	8.2	33	17	.3
West North Central area: Total [4]	**13**	**6,754**	**16,726**	**315**	**(1) 2**	**24**	**289**	**18.8**	**.1**	**1.4**	**17.3**	**138**	**17**	**2.6**
Paperboard mills:														
Container and boxboard	4	1,684	3,914	124		3	121	31.7		.8	30.9	31	13	1.0
Minnesota: Total	9	6,172	14,891	262	(1) 2	21	239	17.6	.1	1.4	16.1	145	18	2.6

See footnotes at end of table.

TABLE 2.—Work-injury rates for 534 pulp and paper mills, classified by geographic area, State, type of mill, and extent of disability, 1948—Continued

Geographic area, State, and type of mill	Number of establishments	Number of employees	Employee-hours worked (thousands)	Number of disabling injuries				Frequency rates of [2]—				Severity		
					Resulting in—							Average number of days lost or charged per—		
				Total	Death or permanent-total disability [1]	Permanent-partial disability	Temporary-total disability	All disabling injuries	Deaths and permanent-total disabilities	Permanent-partial disabilities	Temporary-total disabilities	Disabling injury	Temporary-total disability	Severity rate [3]
South Atlantic area: Total [4]	47	30,416	63,753	1,015	(1) 7	109	899	15.9	.1	1.7	14.1	184	19	2.9
Paper mills :														
Book paper	4	7,126	14,772	131	----------	8	123	8.9	--------	.5	8.4	70	26	.6
Coarse paper	9	9,637	20,510	388	4	32	352	18.9	.2	1.6	17.1	189	18	3.6
Fine paper	3	1,579	3,358	34	----------	7	27	10.1	--------	2.1	8.0	431	19	4.4
Paperboard mills :														
Container and boxboard	10	5,059	9.696	164	(1) 2	17	145	16.9	.2	1.8	14.9	184	15	3.1
Florida : Total	5	3,768	8,089	101	3	17	81	12.5	.4	2.1	10.0	334	26	4.2
Georgia : Total [4]	8	6,729	12,805	307	1	20	286	24.0	.1	1.6	22.3	145	14	3.5
Paperboard mills :														
Container and boxboard	3	1,405	1,634	49	1	5	43	30.0	.6	3.1	26.3	171	10	5.1
Maryland : Total	4	2,347	5,234	63	----------	7	56	12.0	--------	1.3	10.7	144	21	1.7
North Carolina : Total [4]	8	6,313	13,023	144	1	15	128	11.1	.1	1.2	9.8	250	20	2.8
Paperboard mills :														
Container and boxboard	3	1,429	2,879	27	----------	5	22	9.4	--------	1.7	7.7	438	15	4.1
South Carolina : Total	3	4,482	9,830	135	(1) 1	30	104	13.7	.1	3.1	10.5	262	23	3.6
Virginia: Total	11	5.859	12,793	219	1	16	202	17.1	.1	1.3	15.7	119	20	2.0
East South Central area: Total [4]	15	12,487	27,218	354	(4) 5	38	311	13.0	.2	1.4	11.4	272	20	3.5
Paperboard mills :														
Container and boxboard	3	827	1,746	61	(3) 4	4	53	34.9	2.3	2.3	30.3	500	14	17.5
Alabama : Total	4	4,059	8,402	104	(3) 3	14	87	12.4	.4	1.7	10.3	432	25	5.3
Mississippi : Total	4	4,975	10,957	182	----------	17	165	16.6	--------	1.6	15.0	134	16	2.2
Tennessee : Total	7	3,453	7,859	68	(1) 2	7	59	8.7	.3	.9	7.5	399	26	3.4
West South Central area: Total [4]	12	8,791	19,522	359	2	16	341	18.4	.1	.8	17.5	97	23	1.8
Paper mills :														
Building paper	4	793	1,766	50	----------	----------	50	28.3	--------	--------	28.3	9	9	.3
Coarse paper	5	6,057	13,390	243	2	14	227	18.1	.1	1.0	17.0	121	29	2.2
Arkansas : Total	3	2,170	4,863	102	1	9	92	21.0	.2	1.9	18.9	135	27	2.8
Louisiana : Total [4]	4	4,448	9,817	146	1	5	140	14.9	.1	.5	14.3	108	30	1.6
Paper mills :														
Coarse paper	3	3,920	8,593	141	1	5	135	16.4	.1	.6	15.7	111	30	1.8
Texas : Total	5	2,173	4,843	111	----------	2	109	22.9	--------	.4	22.5	48	9	1.1
Pacific area: Total [4]	32	16,522	34,379	509	4	28	477	14.8	.1	.8	13.9	138	27	2.0
Paper mills :														
Building paper	5	1,763	3,716	21	1	1	19	5.7	.3	.3	5.1	319	21	1.8
Coarse paper	3	3,032	6,437	60	1	6	53	9.3	.2	.9	8.2	285	79	2.7
Paperboard mills :														
Container and boxboard	7	4,351	8,887	115	----------	4	111	12.9	--------	.5	12.4	81	27	1.1
California : Total [4]	9	3,797	8,002	99	1	5	93	12.4	.1	.6	11.7	145	18	1.8
Paper mills :														
Building paper	4	1,746	3,686	19	1	1	17	5.2	.3	.3	4.6	346	16	1.8
Paperboard mills :														
Container and boxboard	3	1,778	3,701	69	----------	4	65	18.6	--------	1.1	17.5	110	20	2.1
Oregon : Total	6	2,534	5,330	93	----------	1	92	17.4	--------	.2	17.2	28	20	.5
Washington : Total	17	10,191	21,047	317	3	22	292	15.1	.1	1.0	14.0	168	32	2.5

[1] Figures in parentheses indicate the number of permanent-total disability cases included.

[2] The frequency rate is the average number of disabling injuries per million hours worked. A disabling work injury is one which results in (a) death, or (b) any degree of permanent physical impairment, or (c) renders the injured unable to work at any regularly established job open and available to him, throughout the hours corresponding to his regular shift on any day after the day of injury.

[3] The severity rate is the average number of days lost per thousand hours worked.

[4] Totals include figures not shown separately because of insufficient data.

[5] Less than 0.05.

TABLE 3.—Work-injury rates for 534 pulp and paper mills, classified by size of plant and by extent of disability, 1948

Average number of employees	Number of establishments	Number of employees	Employee-hours worked (thousands)	Number of disabling injuries				Frequency rates of [2]—				Severity		
				Total	Resulting in—			All disabling injuries	Deaths and permanent-total disabilities	Permanent partial disabilities	Temporary-total disabilities	Average number of days lost or charged per—		Severity rate [3]
					Death or permanent-total disability [1]	Permanent-partial disability	Temporary-total disability					Disabling injury	Temporary-total disability	
Total	534	207,309	454,207	9,012	(10) 55	510	8,447	19.8	0.1	1.1	18.6	123	18	2.4
1 to 49	76	2,354	5,293	166	1	12	153	31.4	.2	2.3	28.9	182	14	5.7
50 to 99	89	6,470	14,312	507	4	16	487	35.4	.3	1.1	34.0	98	13	3.5
100 to 249	148	24,536	55,104	1,835	(5) 19	75	1,741	33.3	.3	1.4	31.6	130	17	4.3
250 to 499	91	32,110	71,061	1,854	(2) 9	94	1,751	26.1	.1	1.3	24.7	120	17	3.1
500 to 749	50	30,344	65,351	1,116	(1) 6	80	1,030	17.1	.1	1.2	15.8	123	16	2.1
750 to 999	29	25,236	54,705	876	(1) 5	51	820	16.0	.1	.9	15.0	116	17	1.9
1,000 to 1,499	24	29,080	62,975	1,018	(1) 7	70	941	15.9	.1	1.1	14.7	138	23	2.2
1,500 to 1,999	15	25,193	55,073	528	4	70	454	9.6	.1	1.3	8.2	185	20	1.8
2,000 and over	12	31,986	69,333	1,112	----------	42	1,070	16.0	----------	.6	15.4	82	19	1.3

[1] Figures in parentheses indicate the number of permanent-total disability cases included.

[2] The frequency rate is the average number of disabling injuries per million hours worked. A disabling work injury is one which results in (a) death, or (b) any degree of permanent physical impairment, or (c) renders the injured unable to work at any regularly established job open and available to him, throughout the hours corresponding to his regular shift on any day after the day of injury.

[3] The severity rate is the average number of days lost per thousand hours worked.

TABLE 4.—Work-injury rates for 507 pulp and paper mills, classified by kind of safety organization and by extent of disability, 1948

Safety organizations	Number of establishments	Number of employees	Employee-hours worked (thousands)	Number of disabling injuries				Frequency rates of [2]—				Severity		
				Total	Resulting in—			All disabling injuries	Deaths and permanent-total disabilities	Permanent-partial disabilities	Temporary-total disabilities	Average number of days lost or charged per—		Severity rate [3]
					Death or permanent-total disability [1]	Permanent-partial disability	Temporary-total disability					Disabling injury	Temporary-total disability	
Establishments employing full-time safety engineers [4]	148	112,919	247,805	3,784	(3) 24	272	3,488	15.3	0.1	1.1	14.1	142	20	2.2
And with safety committees [4]	137	108,366	238,107	3,600	(2) 20	262	3,318	15.1	.1	1.1	13.9	141	20	2.1
Composed of nonsupervisory employees	11	9,740	21,315	189	----------	13	176	8.9	----------	.6	8.3	135	24	1.2
Composed of supervisory employees	12	11,198	24,227	424	2	37	385	17.5	.1	1.5	15.9	197	18	3.4
Composed of both supervisory and nonsupervisory employees	110	85,039	187,216	2,905	(1) 17	209	2,679	15.5	.1	1.1	14.3	134	20	2.1
But without safety committees	11	4,553	9,698	184	(1) 4	10	170	19.0	.4	1.0	17.6	176	16	3.3
Establishments without full-time safety engineers [4]	359	87,692	191,595	4,885	(7) 30	226	4,629	25.5	.2	1.2	24.1	111	16	2.8
But with safety committees [4]	254	76,300	166,700	4,118	(7) 27	200	3,891	24.7	.2	1.2	23.3	115	16	2.8
Composed of nonsupervisory employees	17	4,947	11,341	254	1	10	243	22.4	.1	.9	21.4	80	15	1.8
Composed of supervisory employees	58	14,714	31,652	821	(1) 5	46	770	25.9	.2	1.5	24.2	116	15	3.0
Composed of both supervisory and nonsupervisory employees	178	56,371	123,185	3,032	(6) 21	144	2,867	24.6	.2	1.2	23.2	119	16	2.9
And without safety committees	102	11,084	24,184	753	3	25	725	31.1	.1	1.0	30.0	85	16	2.6

[1] Figures in parentheses indicate the number of permanent-total disability cases included.

[2] The frequency rate is the average number of disabling injuries per million hours worked. A disabling work injury is one which results in (a) death, or (b) any degree of permanent physical impairment, or (c) renders the injured unable to work at any regularly established job open and available to him, throughout the hours corresponding to his regular shift on any day after the day of injury.

[3] The severity rate is the average number of days lost per thousand hours worked.

[4] Totals include figures not shown separately because of insufficient data.

TABLE 5.—Work injury rates for 534 pulp and paper mills, classified by department and by extent of disability, 1948

Department	Number of establishments	Number of employees	Employee-hours worked (thousands)	Number of disabling injuries				Frequency rates of [2]—				Severity		
				Total	Resulting in—			All disabling injuries	Deaths and permanent-total disabilities	Permanent-partial disabilities	Temporary-total disabilities	Average number of days lost or charged per—		Severity rate [3]
					Death or permanent-total disability [1]	Permanent-partial disability	Temporary-total disability					Disabling injury	Temporary-total disability	
Total [4]	534	207,309	454,207	9,012	(10) 55	510	8,447	19.8	0.1	1.1	18.6	123	18	2.4
Production departments:														
Woodyards	132	5,193	11,368	469	2	14	453	41.3	0.2	1.2	39.9	79	15	3.3
Wood rooms	115	4,725	10,281	309	5	28	276	30.1	.5	2.7	26.9	214	20	6.4
Rag shredding	30	502	1,054	27		2	25	25.6		1.9	23.7	71	17	1.8
Groundwood mills	72	2,436	5,403	157		7	150	29.1		1.3	27.8	58	18	1.7
Sulfite mills	57	2,460	5,411	114		6	108	21.1		1.1	20.0	72	18	1.5
Sulfate mills	29	3,549	7,602	137	(2) 4	6	127	18.0	.5	.8	16.7	265	22	4.8
Soda mills	11	732	1,664	33		2	31	19.8		1.2	18.6	196	21	3.9
Rag mills	8	866	1,904	13			13	6.8			6.8	9	9	.1
Wet rooms	66	1,638	3,716	62		3	59	16.7		.8	15.9	55	22	.9
Bleaching	87	1,529	3,479	68		2	66	19.5		.6	18.9	22	14	.4
Beater rooms	401	10,078	22,508	596	(1) 8	13	575	26.5	.4	.6	25.5	125	18	3.3
Paper machine rooms	456	23,847	53,702	1,619	(4) 13	117	1,489	30.1	.2	2.2	27.7	167	18	5.0
Finishing	335	23,475	50,271	831	(1) 1	40	790	16.5	[5]	.8	15.7	94	18	1.6
Converting	156	27,196	57,098	972	2	51	919	17.0	[5]	.9	16.1	83	14	1.4
Service departments:														
Administrative and clerical	431	20,636	43,293	59	1	4	54	1.4	[5]	.1	1.3	268	22	.4
Garage	104	723	1,645	37		4	33	22.5		2.4	20.1	253	17	5.7
Laboratory	242	3,141	6,677	36		2	34	5.4		.3	5.1	144	12	.8
Plant maintenance	446	25,664	58,637	1,362	(1) 7	102	1,253	23.2	.1	1.7	21.4	128	20	3.0
Power plants	411	7,892	18,237	330	2	18	310	18.1	.1	1.0	17.0	127	20	2.3
Shipping	116	2,660	6,012	105		5	100	17.5		.8	16.7	102	15	1.8
Stock room	230	1,749	4,147	107	2	2	103	25.8	.5	.5	24.8	133	16	3.4
Watchmen	292	1,623	3,543	36	1	1	34	10.2	.3	.3	9.6	205	26	2.1
Yard	150	3,558	7,757	256		6	250	33.0		.8	32.2	53	19	1.8

[1] Figures in parentheses indicate the number of permanent-total disability cases included.

[2] The frequency rate is the average number of disabling injuries per million hours worked. A disabling work injury is one which results in (a) death, or (b) any degree of permanent physical impairment, or (c) renders the injured unable to work at any regularly established job open and available to him, throughout the hours corresponding to his regular shift on any day after the day of injury.

[3] The severity rate is the average number of days lost per thousand hours worked.

[4] Totals include figures not shown separately because of insufficient data.

[5] Less than 0.05.

TABLE 6.—Distribution of work-injury-frequency rates for 534 pulp and paper mills by size of plant, 1948

Average number of employees	Number of establishments	Number of establishments with frequency rates of [1]—													
		0	1–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–49	50–59	60–69	70–99	100 and over
Total	534	52	28	57	49	63	41	44	37	31	42	35	24	18	13
1–49	76	34		2	1	2	4	3	4	2	5	3	5	6	5
50–99	89	11		12	4	6	3	5	7	6	9	9	7	5	5
100–249	148	6	5	9	10	22	11	12	12	12	13	17	10	6	3
250–499	91	1	4	9	10	12	10	9	11	5	12	6	1	1	
500–749	50		11	5	6	7	6	7	2	3	3				
750–999	29		3	5	8	4	3	3	1	2					
1,000–1,499	24		1	6	6	5	1	4					1		
1,500–1,999	15		3	7	1	3		1							
2,000 and over	12		1	2	3	2	3			1					

[1] The frequency rate is the average number of disabling injuries per million hours worked. A disabling work injury is one which results in (a) death, or (b) any degree of permanent physical impairment, or (c) renders the injured unable to work at any regularly established job open and available to him, throughout the hours corresponding to his regular shift on any day after the day of injury.

TABLE 7.—Number of establishments, employees, injuries, and days lost in 534 pulp and paper mills, classified by injury-frequency rates, 1948

Frequency rates of establishments [1]	Establishments			Employees			Injuries			Days lost		
	Number	Cumulative		Number	Cumulative		Number	Cumulative		Number	Cumulative	
		Number	Percent		Number	Percent		Number	Percent		Number	Percent
100 and over	13	13	2.4	852	852	.4	278	278	3.1	19,082	19,082	1.7
90–99	5	18	3.4	553	1,405	.7	113	391	4.3	12,083	31,165	2.8
80–89	3	21	3.9	441	1,846	.9	86	477	5.3	1,363	32,528	2.9
75–79	4	25	4.7	194	2,040	1.0	36	513	5.7	2,687	35,215	3.2
70–74	6	31	5.8	938	2,978	1.4	156	669	7.4	18,651	53,866	4.8
65–69	11	42	7.9	1,072	4,050	2.0	151	820	9.1	40,791	94,657	8.5
60–64	13	55	10.3	2,884	6,934	3.3	406	1,226	13.6	17,252	111,909	10.1
55–59	13	68	12.7	2,022	8,956	4.3	255	1,481	16.4	19,110	131,019	11.8
50–54	22	90	16.9	3,388	12,344	6.0	382	1,863	20.7	54,141	185,160	16.7
45–49	16	106	19.9	2,791	15,135	7.3	291	2,154	23.9	28,737	213,897	19.2
40–44	26	132	24.7	5,988	21,123	10.2	522	2,676	29.7	51,980	265,877	23.9
35–39	31	163	30.5	9,897	31,020	15.0	844	3,520	39.1	79,225	345,102	31.1
30–34	37	200	37.5	8,579	39,599	19.1	619	4,139	45.9	52,463	397,565	35.8
25–29	44	244	45.7	18,766	58,365	28.2	1,071	5,210	57.8	102,448	500,013	45.0
20–24	41	285	53.4	23,212	81,577	39.4	1,118	6,328	70.2	103,552	603,565	54.3
15–19	63	348	65.2	32,294	113,871	54.9	1,199	7,527	83.5	120,655	724,220	65.2
10–14	49	397	74.3	32,014	145,885	70.4	799	8,326	92.4	132,162	856,382	77.1
9	9	406	76.0	5,375	151,260	73.0	111	8,437	93.6	51,565	907,947	81.7
8	11	417	78.1	6,503	157,763	76.1	112	8,549	94.9	57,152	965,099	86.8
7	10	427	80.0	7,239	165,002	79.6	105	8,654	96.0	18,874	983,973	88.5
6	11	438	82.0	9,634	174,636	84.2	129	8,783	97.5	39,651	1,023,624	92.1
5	16	454	85.0	8,378	183,014	88.3	93	8,876	98.5	36,111	1,059,735	95.3
4	10	464	86.9	5,209	188,223	90.8	46	8,922	99.0	22,656	1,082,391	97.4
3	12	476	89.1	9,765	197,988	95.5	63	8,985	99.7	12,556	1,094,947	98.5
1 and 2	6	482	90.3	6,240	204,228	98.5	27	9,012	100.0	16,478	1,111,425	100.0
0	52	534	100.0	3,081	207,309	100.0	----------	9,012	100.0	----------	1,111,425	100.0

[1] The frequency rate is the average number of disabling injuries per million hours worked. A disabling work injury is one which results in (a) death, or (b) any degree of permanent physical impairment, or (c) renders the injured unable to work at any regularly established job open and available to him, throughout the hours corresponding to his regular shift on any day after the day of injury.

TABLE 8.—Disabling work injuries in 106 pulp and paper mills, classified by nature of injury and by type of mill, 1948

Nature of injury	Total number of injuries [1]		Type of mill															
			Book-paper mills		Coarse-paper mills		Container and box-board mills		Fine-paper mills		Ground-wood-paper mills		Newsprint mills		Pulp mills		Sanitary-paper mills	
	Number	Percent [2]	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total	3,286	100.0	615	100.0	729	100.0	172	100.0	360	100.0	121	100.0	390	100.0	205	100.0	164	100.0
Amputations	76	2.3	14	2.3	23	3.2	4	2.3	6	1.7	2	1.7	4	1.0	4	2.0	6	3.7
Bruises, contusions	1,162	35.4	252	40.9	218	30.0	72	41.9	114	31.6	43	35.4	167	42.7	56	27.4	52	31.7
Burns, scalds (except chemical)	139	4.2	22	3.6	54	7.4	9	5.2	6	1.7	6	5.0	8	2.1	5	2.4	10	6.1
Chemical burns	72	2.2	14	2.3	24	3.3	2	1.2	9	2.5	1	.8	7	1.8	9	4.4	1	.6
Cuts, lacerations, punctures	462	14.1	85	13.8	75	10.3	17	9.9	58	16.1	21	17.4	58	14.9	37	18.0	29	17.7
Foreign bodies, not elsewhere classified	70	2.1	19	3.1	14	1.9	------	------	13	3.6	2	1.7	8	2.1	------	------	6	3.7
Fractures	393	12.0	57	9.3	121	16.6	17	9.9	49	13.6	15	12.4	26	6.7	22	10.7	16	9.8
Hernias	116	3.5	15	2.4	47	6.4	4	2.3	4	1.1	1	.8	8	2.1	16	7.8	4	2.4
Industrial diseases	55	1.7	10	1.6	12	1.6	1	.6	13	3.6	3	2.5	1	.3	5	2.4	5	3.0
Strains, sprains (except hernias)	700	21.3	124	20.2	125	17.1	41	23.8	86	23.9	26	21.5	103	26.3	44	21.5	34	20.7
Welder's flash	13	.4	2	.3	6	.8	------	------	2	.6	1	.8	------	------	1	.5	------	------
Other	27	.8	1	.2	10	1.4	5	2.9	------	------	------	------	------	------	6	2.9	1	.6
Unclassified; insufficient data	1	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------

[1] Includes figures not shown separately because of insufficient data.

[2] Percents are based on classified cases only.

TABLE 9.—Disabling work injuries in 106 pulp and paper mills, classified by part of body injured and by type of mill, 1948

Part o fbody injured	Total number of injuries [1]		Type of mill															
			Book-paper mills		Coarse-paper mills		Container and box-board mills		Fine-paper mills		Ground-wood-paper mills		Newsprint mills		Pulp mills		Sanitary-paper mills	
	Number	Percent [2]	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total	3,286	100.0	615	100.0	729	100.0	172	100.0	360	100.0	121	100.0	390	100.0	205	100.0	164	100.0
Head	333	10.1	57	9.3	96	13.2	11	6.4	42	11.7	12	9.9	30	7.7	29	14.1	12	7.3
Eye	177	5.3	36	5.9	49	6.8	2	1.2	32	8.9	7	5.8	11	2.8	14	6.8	8	4.9
Brain and skull	48	1.5	3	.5	28	3.8	5	2.9					3	.8	7	3.4		
Other	108	3.3	18	2.9	19	2.6	4	2.3	10	2.8	5	4.1	16	4.1	8	3.9	4	2.4
Trunk	799	24.3	129	21.0	173	23.7	51	29.7	74	20.6	32	26.4	103	26.4	60	29.3	38	23.2
Chest (lungs), ribs, etc	111	3.4	23	3.7	19	2.6	4	2.3	13	3.6	8	6.6	17	4.4	8	3.9	3	1.8
Back	391	11.8	53	8.7	65	8.9	32	18.6	41	11.4	22	18.2	60	15.4	30	14.7	17	10.4
Abdomen	173	5.3	24	3.9	62	8.5	8	4.7	9	2.5	1	.8	13	3.3	21	10.2	9	5.5
Hip or pelvis	41	1.2	10	1.6	12	1.6			6	1.7			2	.5			2	1.2
Shoulder	81	2.5	19	3.1	15	2.1	7	4.1	4	1.1	1	.8	11	2.8	1	.8	7	4.3
Other	2	.1							1	.3								
Upper extremities	886	27.0	165	26.8	178	24.4	47	27.3	95	26.4	40	33.1	117	30.0	46	22.4	37	22.6
Arm	169	5.1	29	4.7	38	5.2	10	5.8	17	4.7	10	8.3	17	4.4	8	3.9	12	7.3
Hand	259	7.9	44	7.2	46	6.3	13	7.6	33	9.2	15	12.4	36	9.2	12	5.9	12	7.3
Finger	458	14.0	92	14.9	94	12.9	24	13.9	45	12.5	15	12.4	64	16.4	26	12.6	13	8.0
Lower extremities	1,125	34.3	243	39.5	236	32.4	44	25.6	133	36.9	34	28.1	131	33.6	61	29.8	70	42.6
Leg	378	11.5	85	13.8	77	10.6	20	11.6	48	13.3	7	5.8	47	12.1	26	12.7	23	14.0
Foot	545	16.6	117	19.0	129	17.7	16	9.3	60	16.7	18	14.9	64	16.4	25	12.2	30	18.2
Toe	202	6.2	41	6.7	30	4.1	8	4.7	25	6.9	9	7.4	20	5.1	10	4.9	17	10.4
Body, general	141	4.3	21	3.4	46	6.3	19	11.0	16	4.4	3	2.5	9	2.3	9	4.4	7	4.3
Unclassified; insufficient data	2																	

[1] Includes figures not shown separately because of insufficient data.

[2] Percents are based on classified cases only.

TABLE 10.—Disabling work injuries in 106 pulp and paper mills, classified by part of body injured and nature of injury, 1948

Part of body injured	Total number of injuries	Nature of injury												
		Amputations	Bruises and contusions	Burns, scalds	Chemical burns	Cuts and lacerations	Foreign bodies	Fractures	Hernias	Industrial diseases	Strains and sprains	Welder's flash	Other	Unclassified; insufficient data
Total	3,286	76	1,162	139	72	462	70	393	116	55	700	13	27	1
Head	333		74	23	36	80	70	19		2	7	13	9	
Eye	177		12	8	32	32	70				1	13	9	
Brain or skull	48		28			16		4						
Other	108		34	15	4	32		15		2	6			
Trunk	799		194	6	3	7		49	116		423		1	
Chest (lungs), ribs, etc	111		55	2	1	3		26			23		1	
Back	391		57	2	2	1		10			319			
Abdomen	173		18	2					116		37			
Hip or pelvis	41		26			3		4			8			
Shoulder	81		36					9			36			
Other	2		2											
Upper extremities	886	73	334	32	5	256		108		6	71		1	
Arm	169	4	73	18	1	26		23		1	23			
Hand	259	3	91	12	4	73		31		5	39		1	
Finger	458	66	170	2		157		54			9			
Lower extremities	1,125	3	528	41	18	118		216		1	199		1	
Leg	378		209	15	6	60		34			54			
Foot	545		210	26	12	50		102			144		1	
Toe	202	3	109			8		80		1	1			
Body, general	141		32	36	10	1		1		46			15	
Unclassified; insufficient data	2			1										1

TABLE 11.—Percentage distribution of disabling work injuries in 106 pulp and paper mills, classified by department and by part of body injured, 1948

Department	Total number of injuries	Percentage distribution by part of body injured																		
		Head				Trunk							Upper extremities				Lower extremities				Body, general
		Total	Eye	Brain or skull	Other	Total	Chest, ribs, etc.	Back	Abdomen	Hip or pelvis	Shoulder	Other	Total	Arm	Hand	Finger	Total	Leg	Foot	Toe	
Total [1]	3,286	10.1	5.3	1.5	3.3	24.3	3.4	11.8	5.3	1.2	2.5	0.1	27.0	5.1	7.9	14.0	34.3	11.5	16.6	6.2	4.3
Woodyard	359	8.1	.6	2.8	4.7	21.4	4.7	10.0	3.1	1.4	2.2	------	20.9	2.8	7.0	11.1	48.8	15.0	25.2	8.6	.8
Wood room	233	9.0	3.0	3.4	2.6	23.2	1.3	11.1	5.2	1.3	3.9	.4	30.0	2.6	7.3	20.1	36.1	13.7	17.2	5.2	1.7
Pulp mills	334	15.0	9.3	1.5	4.2	19.2	1.2	10.5	4.2	.6	2.7	------	21.0	3.9	7.8	9.3	32.2	10.5	17.2	4.5	12.6
Wet rooms	54	1.9	1.9	------	------	40.7	5.6	14.7	14.8	3.7	1.9	------	14.8	5.6	5.5	3.7	31.5	11.1	13.0	7.4	11.1
Beater rooms	204	8.3	3.9	1.5	2.9	33.4	3.4	18.7	7.8	2.0	1.5	------	23.5	7.8	8.3	7.4	31.4	16.2	9.8	5.4	3.4
Paper machine rooms	558	6.1	2.8	1.1	2.2	20.6	3.0	10.2	4.5	1.4	1.3	.2	41.4	7.7	12.7	21.0	29.7	8.6	14.6	6.5	2.2
Finishing	388	5.9	3.8	.5	1.6	26.1	3.6	11.6	7.5	1.8	1.6	------	33.3	4.9	10.3	18.1	34.2	10.9	14.8	8.5	.5
Shipping	119	6.7	4.2	.8	1.7	35.3	6.7	16.9	4.2	.8	6.7	------	16.8	2.5	5.9	8.4	40.4	16.8	20.2	3.4	.8
Yard	159	6.3	1.9	.6	3.8	28.9	3.1	13.8	6.3	------	5.7	------	23.9	5.0	6.9	12.0	35.9	8.8	17.7	9.4	5.0
Maintenance	692	16.2	11.3	1.3	3.6	22.5	3.8	11.9	4.2	.9	1.7	------	23.7	6.4	5.2	12.1	31.1	9.4	16.8	4.9	6.5
Power	93	14.0	4.3	2.2	7.5	32.2	4.3	12.9	11.8	------	3.2	------	18.3	2.2	3.2	12.9	25.8	11.8	9.7	4.3	9.7

[1] Includes figures not shown separately because of insufficient data.

TABLE 12.—Disabling injury and medical treatment cases in 51 pulp and paper mills, classified by nature of injury, 1948

Nature of injury	Total number of injuries		Number of disabling injuries [1]		Number of medical injuries [2]		Average number of medical injuries per disabling injury
	Number	Percent	Number	Percent	Number	Percent	
Total	4,170	100.0	1,209	100.0	2,961	100.0	2.4
Amputations	33	.8	33	2.7	------	------	------
Bruises, contusions	1,370	32.9	412	34.2	958	32.3	2.3
Burns, scalds (except chemical)	139	3.3	62	5.1	77	2.6	1.2
Chemical burns	100	2.4	29	2.4	71	2.4	2.4
Cuts, lacerations, punctures	954	22.9	152	12.6	802	27.1	5.3
Foreign bodies, not elsewhere classified	481	11.5	18	1.5	463	15.6	25.7
Fractures	233	5.6	148	12.2	85	2.9	.6
Hernias	67	1.6	67	5.5	------	------	------
Industrial diseases	60	1.4	25	2.1	35	1.2	1.4
Strains, sprains (except hernias)	674	16.2	243	20.1	431	14.6	1.8
Welder's flash	21	.5	4	.3	17	.6	4.3
Other	38	.9	16	1.3	22	.7	1.4

[1] A disabling work injury is one which results in (a) death, or (b) any degree of permanent physical impairment, or (c) renders the injured unable to work at any regularly established job open and available to him, throughout the hours corresponding to his regular shift on any day after the day of injury.

[2] A medical injury is one which does not result in death, permanent impairment, or temporary disability but requires treatment by a physician or surgeon.

TABLE 13.—Disabling injury and medical treatment cases in 51 pulp and paper mills, classified by part of body injured, 1948

Part of body injured	Total number of injuries		Number of disabling injuries [1]		Number of medical injuries [2]		Average number of medical injuries per disabling injury
	Number	Percent	Number	Percent	Number	Percent	
Total	4,170	100.0	1,209	100.0	2,961	100.0	2.4
Head	978	23.5	124	10.3	854	28.8	6.9
Eye	647	15.5	59	4.9	588	19.8	10.0
Brain and skull	141	3.4	29	2.4	112	3.8	3.9
Other	190	4.6	36	3.0	154	5.2	4.3
Trunk	778	18.7	313	25.9	465	15.7	1.5
Chest (lungs) ribs, etc	139	3.3	33	2.7	106	3.6	3.2
Back	339	8.2	147	12.1	192	6.4	1.3
Abdomen	178	4.3	89	7.4	89	3.0	1.0
Hip or pelvis	37	.9	13	1.1	24	.8	1.8
Shoulder	79	1.9	30	2.5	49	1.7	1.6
Other	6	.1	1	.1	5	.2	5.0
Upper extremities	1,354	32.4	318	26.3	1,036	35.0	3.3
Arm	233	5.6	69	5.7	164	5.5	2.4
Hand	383	9.2	91	7.5	292	9.9	3.2
Finger	738	17.6	158	13.1	580	19.6	3.7
Lower extremities	940	22.5	381	31.5	559	18.9	1.5
Leg	337	8.1	129	10.7	208	7.0	1.6
Foot	428	10.2	184	15.2	244	8.3	1.3
Toe	175	4.2	68	5.6	107	3.6	1.6
Body, general	120	2.9	73	6.0	47	1.6	.6

[1] A disabling work injury is one which results in (a) death, or (b) any degree of permanent physical impairment, or (c) renders the injured unable to work at any regularly established job open and available to him, throughout the hours corresponding to his regular shift on any day after the day of injury.

[2] A medical injury is one which does not result in death, permanent impairment, or temporary disability but requires treatment by a physician or surgeon.

TABLE 14.—Distribution of 4,170 disabling injury and medical treatment cases reported by 51 pulp and paper mills, classified by accident type and agency of injury, 1948

Accident type	Total number of accidents	Agency of injury																			
		Foreign bodies	Machines[1]	Hand tools	Pulpwood logs	Working surfaces	Paper	Vehicles	Bodily motion	Metal parts	Chemicals	Lumber	Pipes and piping	Containers	Chips and splinters	Shells and cores	Hoisting apparatus	Conveyors	Wire and cables	Other	Unclassified; insufficient data
Total : Number	4,170	475	462	391	283	243	231	199	191	182	176	126	107	93	91	86	68	53	45	641	27
Percent [2]	100.0	11.5	11.2	9.4	6.8	5.9	5.6	4.8	4.6	4.4	4.2	3.0	2.6	2.2	2.2	2.1	1.6	1.3	1.1	15.5	
Struck by : Total	1,557	475	33	294	172	1	60	51		89		42	31	33	33	38	34	1	22	144	4
Flying or thrown objects : Total	638	475	9	17	34		2	1		6		14	7	1	31		1		18	22	
Particles	513	475								1					28					9	
Other	125		9	17	34		2	1		5		14	7	1	3		1		18	13	
Falling objects : Total	506		11	25	132	1	37	8		74		24	19	29	1	34	17			91	3
From hands of workers	208		1	9	54		15	2		35		8	7	14		21	1			41	
From equipment	148		9	8	34		17	4		22		1	4	3		11	16			18	1
From other sources	150		1	8	44	1	5	2		17		15	8	12	1	2				32	2
Hand-operated or -wielded objects	303			244			13	30				3	2			3				8	
Mechanically powered equipment	45		13	3				12									16	1			
Rolling objects	16				3		6			4			1							2	
Other objects	49			5	3		2			5		1	2	3	1	1			4	21	1
Striking against : Total	607		166	18	17	13	18	36		20	1	62	19	12	52	4	6	14	18	127	4
Bumping into or against equipment : Total	306		159	10				31		4			19		1	3	3	14		62	
Moving parts of powered equipment	65		63	1				1													
Other parts of powered equipment	122		94					7							1		2	13		5	
Other equipment	119		2	9				23		4			19			3	1	1		57	
Rubbing against or striking slivers, splinters, etc	83		2		1			1		1		8		2	51		1		1	15	
Stepping on objects	53			1		2		1				44							3	2	
Striking against projecting nails, wires, etc	51		4	1	1	1	6	1		1		6		6		1	1		13	9	
Striking against materials	42				13		11			5	1	4		2					1	5	
Striking against other objects	72		1	6	2	10	1	2		9				2			1			34	4
Caught in, on, or between : Total	583		198	48	23	4	47	51		38		7	22	8		22	21	23	3	68	
Moving parts of equipment : Total	245		188	1		2		1									13	20		20	
Points-of-operation	125		123	1		1															
Gears, pulleys, etc	69		33														9	16		11	
Other parts	51		32			1		1									4	4		9	
Objects being lifted or placed	128		3	2	9		19	1		27		6	12	6		16		2	1	24	
Rolling or falling objects	74		1	1	11	1	25	1		10		1	9	1		3	1			9	
Wheeled equipment and other objects	48		1					45									1			1	
Hand tools and other objects	46		2	44																	
Other objects	42		3		3	1	3	3		1			1	1		3	6	1	2	14	
Overexertion—due to: Total	377		10	27	40	1	97	27		23		6	13	36		18	5	2	2	68	2
Lifting objects	235		1	2	27		63	11		22		6	6	32		12	1	1	1	49	1
Pulling objects	63		4	9	2		16	8					1	2		5	4	1	1	10	
Other operations	79			16	11	1	18	8		1			6	2		1				9	1

See footnotes at end of table.

TABLE 14.—Distribution of 4,170 disabling injury and medical treatment cases reported by 51 pulp and paper mills, classified by accident type and agency of injury, 1948—Continued

Accident type	Total number of accidents	Agency of injury																		
		Foreign bodies	Machines[1]	Hand tools	Pulpwood logs	Working surfaces	Paper	Vehicles	Bodily motion	Metal parts	Chemicals	Lumber	Pipes and piping	Containers	Chips and splinters	Shells and cores	Hoisting apparatus	Conveyors	Wire and cables	Other	Unclassified; insufficient data
Falls—on same level: Total	294	-------	25	3	22	133	3	18	-------	6	-------	4	6	2	-------	1	1	9	-------	61	-------
Resulting from slips: Total	181	-------	21	2	6	84	2	9	-------	3	-------	4	5	-------	-------	1	-------	9	-------	35	-------
On floors	111	-------	15	1	2	66	2	-------	-------	2	-------	2	4	-------	-------	1	-------	-------	-------	16	-------
On other surfaces	70	-------	6	1	4	18	-------	9	-------	1	-------	2	1	-------	-------	-------	-------	9	-------	19	-------
Resulting from stumbles	28	-------	2	-------	2	12	-------	1	-------	1	-------	-------	1	1	-------	-------	-------	-------	-------	8	-------
Other	85	-------	2	1	14	37	1	8	-------	2	-------	-------	-------	1	-------	-------	1	-------	-------	18	-------
Slips and stumbles (not falls): Total	231	-------	17	-------	2	8	1	10	148	2	-------	4	8	-------	-------	2	-------	1	-------	28	-------
Slips: Total	182	-------	16	-------	2	7	1	8	112	2	-------	2	5	-------	-------	1	-------	1	-------	25	-------
On floors	91	-------	7	-------	-------	2	1	2	66	-------	-------	-------	4	-------	-------	1	-------	-------	-------	8	-------
On other surfaces	91	-------	9	-------	2	5	-------	6	46	2	-------	2	1	-------	-------	-------	-------	1	-------	17	-------
Stumbles	49	-------	1	-------	-------	1	-------	2	36	-------	-------	2	3	-------	-------	1	-------	-------	-------	3	-------
Inhalation, absorption: Total	193	-------	-------	-------	4	-------	4	-------	-------	-------	156	-------	-------	1	-------	-------	-------	-------	-------	27	1
Absorption resulting in: Total	163	-------	-------	-------	4	-------	4	-------	-------	-------	128	-------	-------	-------	-------	-------	-------	-------	-------	26	1
Chemical burns	98	-------	-------	-------	-------	-------	-------	-------	-------	-------	97	-------	-------	-------	-------	-------	-------	-------	-------	1	-------
Dermatoses	32	-------	-------	-------	4	-------	4	-------	-------	-------	19	-------	-------	-------	-------	-------	-------	-------	-------	4	1
Other injuries	33	-------	-------	-------	-------	-------	-------	-------	-------	-------	12	-------	-------	-------	-------	-------	-------	-------	-------	21	-------
Inhalation	30	-------	-------	-------	-------	-------	-------	-------	-------	-------	28	-------	-------	1	-------	-------	-------	-------	-------	1	-------
Contact with extreme temperatures: Total	128	-------	7	1	-------	-------	-------	-------	-------	3	18	-------	5	-------	6	-------	-------	-------	-------	88	-------
Hot liquids	45	-------	-------	-------	-------	-------	-------	-------	-------	-------	16	-------	-------	-------	-------	-------	-------	-------	-------	29	-------
Hot solids	34	-------	7	1	-------	-------	-------	-------	-------	3	2	-------	5	-------	6	-------	-------	-------	-------	10	-------
Other	49	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	49	-------
Falls—to lower levels: Total	122	-------	6	-------	3	83	1	6	-------	1	-------	1	3	1	-------	1	1	3	-------	11	1
From platforms, gangways, etc.	33	-------	1	-------	2	21	-------	3	-------	-------	-------	-------	1	1	-------	1	-------	-------	-------	3	-------
From ladders	24	-------	-------	-------	-------	20	-------	-------	-------	-------	-------	1	1	-------	-------	-------	1	-------	-------	-------	1
From other elevations	65	-------	5	-------	1	42	1	3	-------	1	-------	-------	1	-------	-------	-------	-------	3	-------	8	-------
Other	62	-------	-------	-------	-------	-------	-------	-------	43	-------	1	-------	-------	-------	-------	-------	-------	-------	-------	18	-------
Unclassified; insufficient data	16	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	1	15

[1] Includes paper machines, winding reels, calender stocks, etc., but excludes hoisting apparatus, vehicles, and electrical equipment.

[2] Percentages are based on classified cases only.

TABLE 15.—Percentage distribution of 4,170 disabling and medical treatment cases reported by 51 pulp and paper mills, by type of accident and by department, 1948

Accident type	Total number of accidents [1]	Department										
		Wood-yard	Wood room	Pulp mill	Wet room	Beater room	Paper-machine room	Finish-ing	Ship-ping	Yard	Main-tenance	Power
Total	[2] 4,170	[2] 407	[2] 221	[2] 322	[2] 81	[2] 270	[2] 692	[2] 288	[2] 160	[2] 240	[2] 1,191	[2] 145
Struck by : Total	37.5	55.8	44.3	28.4	29.7	24.0	29.3	33.2	32.7	35.7	43.7	36.2
Flying or thrown objects : Total	15.3	10.6	18.9	10.3	16.1	6.7	9.2	10.2	8.8	11.8	26.7	16.8
Particles	12.3	6.4	8.6	8.4	16.1	3.4	7.5	7.8	6.3	10.1	23.2	16.1
Other	3.0	4.2	10.3	1.9		3.3	1.7	2.4	2.5	1.7	3.5	.7
Falling objects: Total	12.2	22.6	14.9	10.7	4.9	5.2	11.0	14.1	13.8	15.1	10.5	8.3
From hands of workers	5.0	9.1	4.1	3.5	2.5	1.5	5.5	6.0	7.5	7.1	4.5	1.4
From equipment	3.6	4.7	6.3	4.1	1.2	1.1	3.9	4.3	3.1	3.8	3.1	4.1
From other sources	3.6	8.8	4.5	3.1	1.2	2.6	1.6	3.8	3.1	4.2	2.9	2.8
Hand-operated or -wielded objects	7.3	19.9	8.6	6.2	6.2	9.9	6.8	3.1	5.0	5.0	4.6	9.7
Mechanically powered equipment	1.1	1.2	.9	.6		.7	.7	3.1	1.9	2.1	.8	
Rolling objects	.4	.5	.5				.1	1.7	1.9	.4	.3	
Other objects	1.2	1.0	.5	.6	2.5	1.5	1.5	1.0	1.3	1.3	.8	1.4
Striking against : Total	14.6	8.8	17.6	14.0	16.1	16.7	18.6	14.6	12.6	13.0	14.0	8.3
Bumping into or against equipment : Total	7.4	1.9	11.2	6.9	7.5	9.3	13.0	7.0	3.8	3.7	6.3	5.5
Moving parts of powered equipment	1.6		4.5	.3		.7	4.2	1.0	.6	.4	1.5	
Other parts of powered equipment	2.9	1.2	5.3	1.9		3.7	6.5	3.6	1.3	1.3	2.2	
Other equipment	2.9	.7	1.4	4.7	7.5	4.9	2.3	2.4	1.9	2.0	2.6	5.5
Rubbing against or striking slivers, splinters, etc	2.0	1.0	1.4	.3	1.2	1.5	2.9	2.8	3.8	1.3	2.5	
Stepping on objects	1.3	.7		1.2	2.5	.7	.4	1.0	.6	3.8	2.0	.7
Striking against projecting nails, wires, etc	1.2	1.2	.9	.3	3.7	3.0	.4	1.4	2.5	1.7	1.2	
Striking against materials	1.0	2.0	2.3	1.9		1.1	1.0	1.4	1.3		.5	.7
Striking against other objects	1.7	2.0	1.8	3.4	1.2	1.1	.9	1.0	.6	2.5	1.5	1.4
Caught in, on, or between : Total	14.0	9.1	15.8	6.5	11.1	11.9	21.5	18.1	21.4	18.9	11.7	10.4
Moving parts of equipment : Total	5.8	2.9	7.1	3.2	6.2	4.1	14.9	7.4	1.3	2.5	3.8	5.0
Points-of-operation	2.9		1.8	1.7	6.2	.4	10.8	4.3	.7		1.5	2.9
Gears, pulleys, etc	1.7	1.9	3.9	.9		1.1	.9	2.8		1.7	1.8	1.4
Other parts	1.2	1.0	1.4	.6		2.6	3.2	.3	.6	.8	.5	.7
Objects being lifted or placed	3.1	1.5	4.1	.9		2.2	3.8	2.1	6.3	7.5	3.3	2.1
Rolling or falling objects	1.8	2.0	1.4			1.1	1.2	2.4	8.8	2.9	1.9	
Wheeled equipment and other objects	1.2	1.0	.9	.6	2.5	3.0	.3	1.7	3.8	3.4	.6	.7
Hand tools and other objects	1.1		.9	.9	1.2	.4	.6	2.1	.6	1.3	1.7	2.1
Other objects	1.0	1.7	1.4	.9	1.2	1.1	.7	2.4	.6	1.3	.4	.7
Overexertion—due to : Total	9.1	8.6	5.4	8.1	12.3	14.1	9.6	16.4	11.3	12.2	6.1	10.4
Lifting objects	5.7	5.9	1.8	3.7	7.3	8.2	6.3	9.1	5.6	10.5	4.2	4.8
Pulling objects	1.5	.5	1.8	1.9	2.5	2.6	1.3	4.2	1.9	.4	1.3	1.4
Other operations	1.9	2.2	1.8	2.5	2.5	3.3	2.0	3.1	3.8	1.3	.6	4.2
Falls—on same level : Total	7.1	7.4	7.7	6.9	8.6	12.6	7.1	7.3	10.1	6.7	4.2	7.6
Resulting from slips : Total	4.4	3.5	4.1	3.5	7.4	7.7	5.2	4.6	5.7	3.8	2.9	4.1
On floors	2.7	.2	1.8	2.3	6.2	6.6	4.0	4.3	2.5	1.3	1.7	3.4
On other surfaces	1.7	3.3	2.3	1.2	1.2	1.1	1.2	.3	3.2	2.5	1.2	.7
Resulting from stumbles	.7	.7			1.2	1.9	1.2	.3	.6		.3	.7
Other	2.0	3.2	3.6	3.4		3.0	.7	2.4	3.8	2.9	1.0	2.8
Slips and stumbles (not falls) : Total	5.6	3.9	3.6	3.4	7.4	6.3	8.2	6.6	6.3	5.5	4.7	6.9
Slips : Total	4.4	2.9	3.6	1.8	7.4	5.6	6.5	5.9	5.0	4.7	3.2	6.9
On floors	2.2	.5	1.4	1.2	6.2	3.7	3.6	3.8	3.7	1.7	1.4	2.8
On other surfaces	2.2	2.4	2.2	.6	1.2	1.9	2.9	2.1	1.3	3.0	1.8	4.1
Stumbles	1.2	1.0		1.6		.7	1.7	.7	1.3	.8	1.5	
Inhalation, absorption : Total	4.6	1.2	3.2	19.3	2.5	4.8	1.0	.7	.6	5.5	5.6	4.2
Absorption resulting in : Total	3.9	1.2	3.2	14.6	2.5	3.3	1.0	.7	.6	5.1	4.8	4.2
Chemical burns	2.3	.7	.5	11.8	2.5	1.1	.8	.4		3.0	2.5	1.4
Dermatoses	.8		1.8	2.2		1.8	.1	.3	.6	1.7	.4	2.1
Other injuries	.8	.5	.9	.6		.4	.1			.4	1.9	.7
Inhalation	.7			4.7		1.5				.4	.8	
Contact with extreme temperatures : Total	3.1	.5	.5	10.9	8.6	3.3	2.6	.7		.4	3.2	9.7
Hot liquids	1.1			5.0	2.5	1.5	.9	.4			1.1	2.1
Hot solids	.8			2.5			1.1	.3			1.3	1.4
Other	1.2	.5	.5	3.4	6.1	1.8	.6			.4	.8	6.2
Falls—to lower levels : Total	2.9	3.2	1.4	2.2	3.7	3.0	1.5	1.4	5.0	1.7	4.1	4.2
From platforms, gangways, etc	.8	.2		.3	1.2	.4	.6	1.1	2.5	.4	1.1	1.4
From ladders	.6					.4	.1				1.6	.7
From other elevations	1.5	3.0	1.4	1.9	2.5	2.2	.8	.3	2.5	1.3	1.4	2.1
Other	1.5	1.5	.5	.3		3.3	.6	1.0		.4	2.7	2.1

[1] Includes data not shown separately because of insufficient space.

[2] Number of accidents included.

TABLE 16.—Distribution of 4,170 disabling injury and medical treatment cases reported by 51 pulp and paper mills classified by accident type and by unsafe working condition, 1948

Accident type	Total number of accidents	Unsafe working conditions																
		Defective agencies				Hazardous working procedures	Improperly guarded agencies				Lack of personal safety equipment		Hazardous arrangement		Poor housekeeping	Lack of necessary equipment	Other	Unclassified; insufficient data
		Total [1]	Slippery	Projecting nails, wires, etc.	Hidden defects		Total [1]	Lack of point-of-operation guards	Lack of guardrails, toeboards, etc.	Lack of power transmission guards	Total [1]	Goggles	Total [1]	Unsafely stored or piled				
Total	4,170	795	300	88	80	542	452	228	99	43	179	136	148	87	106	48	36	1,864
Struck by : Total	1,557	147	21	3	31	122	91	39	28	1	104	102	103	72	16	5		969
Flying or thrown objects : Total	638	46			20	18	41	32	7	1	104	102	1	1	5	1		422
Particles	513	21			11	3	7	6	1		103	101						379
Other	125	25			9	15	34	26	6	1	1	1	1	1	5	1		43
Falling objects : Total	506	68	16	1	7	54	40	5	21				97	68	3	2		242
From hands of workers	208	24	16			40									3	1		140
From equipment	148	31			5	10	37	5	20				19	10		1		50
From other sources	150	13		1	2	4	3		1				78	58				52
Hand-operated or -wielded objects	303	16	3	1	2	29	1						1	1	2	2		252
Mechanically powered equipment	45	9	1			9	8	2							4			15
Rolling objects	16					4							4	2	1			7
Other objects	49	8	1	1	2	8	1								1			31
Striking against : Total	607	204	3	80	3	30	69	58	4	1	17		17	1	13	8		249
Bumping into or against equipment : Total	306	30	3	2	2	11	68	58	3	1	1		13	1	2	3		178
Moving parts of powered equipment	65	1				1	49	48		1								14
Other parts of powered equipment	122	17	1	2	2	6	18	10	3		1		2	1		2		76
Other equipment	119	12	2			4	1						11		2	1		88
Rubbing against or striking slivers, splinters, etc	83	66									7					1		9
Stepping on objects	53	48		48											3			2
Striking against projecting nails, wires, etc	51	38		30		9					1				2			1
Striking against materials	42	10				8					3				5	1		15
Striking against other objects	72	12				2	1		1		5		4		1	3		44
Caught in, on, or between : Total	583	52	6	2	6	52	193	119	5	41			13	9	4	1	1	267
Moving parts of equipment : Total	245	18	1		2	5	178	116	3	41					1		1	42
Points-of-operation	125	3					116	116										6
Gears, pulleys, etc	69	2					45			41							1	21
Other parts	51	13	1		2	5	17		3						1			15
Objects being lifted or placed	128	13	4			17							2	1	1			95
Rolling or falling objects	74	4			2	13	3	1					9	7	1			44
Wheeled equipment and other objects	48	8		1	1	6	3		2				1	1	1			29
Hand tools and other objects	46	3				3	1	1								1		38
Other objects	42	6	1	1	1	8	8	1					1					19
Overexertion—due to : Total	377	17	4		1	226							1	1		4		129
Lifting objects	235	3	3			169												63
Pulling objects	63	5			1	33										2		23
Other operations	79	9	1			24							1	1		2		43

See footnotes at end of table.

TABLE 16.—Distribution of 4,170 disabling injury and medical treatment cases reported by 51 pulp and paper mills classified by accident type and by unsafe working condition, 1948—Continued

Accident type	Total number of accidents	Unsafe working conditions															
		Defective agencies				Hazardous working procedures	Improperly guarded agencies				Lack of personal safety equipment		Hazardous arrangement		Poor housekeeping	Lack of necessary equipment	Other	Unclassified; insufficient data
		Total [1]	Slippery	Projecting nails, wires, etc.	Hidden defects		Total [1]	Lack of point-of-operation guards	Lack of guardrails, toeboards, etc.	Lack of power transmission guards	Total [1]	Goggles	Total [1]	Unsafely stored or piled				
Falls—on same level : Total	294	161	138	3	2	14	22		21				5	1	26	4	4	58
Resulting from slips : Total	181	143	135	2		5	4		4				1		10	2	1	15
On floors	111	97	93	2		1							1		7			5
On other surfaces	70	46	42			4	4		4						3	2	1	10
Resulting from stumbles	28	3				1	3		3				3		8		1	9
Other	85	15	3	1	2	8	15		14				1	1	8	2	2	34
Slips and stumbles (not falls) : Total	231	125	112			7	4		3				4		41	9	1	40
Slips : Total	182	121	112			7	1								11	9	1	32
On floors	91	71	69			2									8	1		9
On other surfaces	91	50	43			5	1								3	8	1	23
Stumbles	49	4					3		3				4		30			8
Inhalation, absorption : Total	193	29			16	52	12	11	1		51	31	1		3		11	34
Absorption resulting in : Total	163	19			13	49	12	11	1		47	31	1		3		2	30
Chemical burns	98	19			13	30	1		1		30	21			3		1	14
Dermatoses	32					17					6							9
Other injuries	33					2	11	11			11	10	1				1	7
Inhalation	30	10			3	3					4						9	4
Contact with extreme temperatures : Total	128	24	3		10	29	25	1	14		5	3			1		15	29
Hot liquids	45	13	1		6	13	12		11									7
Hot solids	34	2	1			3	9	1			5	3			1			14
Other	49	9	1		4	13	4		3								15	8
Falls—to lower levels : Total	122	32	13		8	6	32		23		2		4	3	2	17	3	24
From platforms, gangways, etc	33	15	4		5	3	5		5						1	5	1	3
From ladders	24	6	3		2	2	8											8
From other elevations	65	11	6		1	1	19		18		2		4	3	1	12	2	13
Other	62	4			3	4	4										1	49
Unclassified; insufficient data	16																	16

[1] Includes data not shown separately because of insufficient space.

TABLE 17.—Distribution of 4,170 disabling injury and medical treatment cases reported by 51 pulp and paper mills, classified by agency of accident and by unsafe working conditions, 1948

Agency of accident	Total number of accidents	Unsafe working conditions																
		Defective agency				Hazardous working procedures	Improperly guarded agency				Lack of personal safety equipment		Hazardous arrangement		Poor housekeeping	Lack of necessary equipment	Other	Unclassified; insufficient data
		Total [1]	Slippery	Projecting nails, wires, etc.	Hidden defects		Total [1]	Lack of point-of-operation guards	Lack of guardrails, toeboards, etc.	Lack of power transmission guards	Total [1]	Goggles	Total [1]	Unsafely stored or piled				
Total	4,170	795	300	88	80	542	452	228	99	43	179	136	148	87	106	48	36	1,864
Working surfaces	440	288	237	6	5	4	42		34				4		98	2	2	
Floors	317	216	187	5	1	2	24		24				4		71			
Yards	65	37	29	1			2		2						26			
Platforms, scaffolds	37	24	13		3	2	8		7							2	1	
Other surfaces	21	11	8		1		8		1						1		1	
Machines [2]	435	79	12	6	9	26	272	216	3	23	36	35	1		1	11	9	
Paper machines	80	26	7	2	3	5	38	28		2					1	4	6	
Winding reels	68	9			1	4	53	47		1			1			1		
Other machines	287	44	5	4	5	17	181	141	3	20	36	35				6	3	
Paper	155	4		1		136					1		10	8		4		
Rolls	79	2				66							8	6		3		
Bales, reams	45	1		1		41							2	2		1		
Other paper	31	1				29					1							
Hand tools	133	44	2		12	12	12	12			62	60	2			1		
Hammers	31	7			6	4					20	19						
Other hand tools	102	37	2		6	8	12	12			42	41	2			1		
Chemicals	108					48					49	26	1				10	
Cooking liquors	30					20					10	6						
Lime	26					10					16	10						
Other chemicals	52					18					23	10	1				10	
Vehicles	98	40	10	4	2	34	8		6				6	2	1	9		
Railway vehicles	41	22	8	2		10	1		1				3	1	1	4		
Hand trucks	34	7		1		20	4		3				2			1		
Motor vehicles	23	11	2	1	2	4	3		2				1	1		4		
Pulpwood logs	95	4	1	1		30					6	1	53	53			2	
Lumber	94	72	4	52		9					3		9	3		1		
Containers	68	12		4		42	2		2				12	8				
Conveyors	65	8	3		1	8	46		31	10			1		1	1		
Metal parts, not elsewhere classified	58	13	4		1	31					1	1	11	1	1	1		
Pipes and piping	52	27			10	9	4		1				9	2		3		
Hoisting apparatus	54	25		1	6	18	8		1	3						3		
Boilers and pressure vessels	48	14			9	17	11		4		2	2					4	
Shafts and cores	36	9	1	1		25							2	1				
Steps, stairs	31	25	20										1		2		3	
Other agencies	328	130	6	12	25	91	47		17	7	17	9	25	9	2	10	6	
Unclassified; insufficient data	1,872	1				2					2	2	1			2		1,864

[1] Includes data not shown separately because of insufficient space.

[2] Includes paper machines, winding reels, calender stacks, etc., but excludes hoisting apparatus, vehicles and electrical equipment.

TABLE 18.—Percentage distribution of 4,170 disabling and medical treatment cases reported by 51 pulp and paper mills, by unsafe working condition and department in which accidents occurred, 1948

Unsafe working condition	Total number of accidents [1]	Department										
		Wood-yard	Wood room	Pulp mill	Wet room	Beater room	Paper-machine room	Finishing	Shipping	Yard	Maintenance	Power
Total	[2] 4,170	[2] 407	[2] 221	[2] 322	[2] 81	[2] 270	[2] 692	[2] 288	[2] 160	[2] 240	[2] 1,191	[2] 145
Defective agency	34.4	26.6	27.2	32.4	53.2	32.3	35.6	32.9	44.0	35.8	35.3	37.4
Slippery	12.9	9.3	11.2	9.6	28.7	16.8	16.3	14.3	17.0	10.8	10.5	14.6
Projecting nails, wires, etc	3.8	4.1	2.4	2.6	10.3	2.5	1.2	2.4	3.2	10.9	5.3	2.4
Hidden defects	3.5	1.5	-------	7.5	2.0	3.1	1.6	3.0	3.2	3.1	4.7	8.4
Projecting splinters, slivers, etc	2.9	1.0	1.6	-------	4.1	1.9	4.2	4.8	5.4	1.6	3.7	-------
Improperly designed or constructed	2.8	1.5	7.2	2.6	-------	2.5	4.4	1.8	6.5	2.3	1.1	4.8
Sharp-edged	1.7	.5	.8	1.1	2.0	1.2	2.3	1.8	-------	1.6	2.6	1.2
Loose	1.4	1.0	-------	1.6	-------	.6	2.3	.6	-------	.8	1.9	-------
Rough or uneven	1.3	4.6	.8	1.1	2.0	-------	.5	1.8	2.2	1.6	.3	1.2
Other defects	4.1	3.1	3.2	6.3	4.1	3.7	2.8	2.4	6.5	3.1	5.2	4.8
Hazardous working procedure	23.5	19.9	15.2	29.6	16.3	33.5	22.7	32.9	36.5	35.2	16.9	19.3
Manual lifting or moving of heavy loads	13.0	8.2	7.2	5.8	10.2	15.5	15.4	25.1	23.6	21.9	9.9	8.5
Working with or around dangerous materials	5.0	2.6	.8	17.5	2.0	13.0	2.1	3.0	3.2	9.4	2.8	4.8
Other	5.5	9.1	7.2	6.3	4.1	5.0	5.2	4.8	9.7	3.9	4.2	6.0
Improperly guarded agency	19.6	16.8	44.8	14.8	16.3	12.4	30.4	19.2	9.7	6.3	17.2	21.7
Lack of point-of-operation guards	9.8	2.0	28.8	2.6	10.2	1.9	23.2	10.8	1.1	.8	8.5	4.8
Lack of toe-boards, guard-rails, etc	4.3	10.8	10.4	8.5	6.1	4.9	.9	1.2	3.2	1.6	3.2	7.2
Lack of power-transmission guards	1.9	2.0	4.8	1.1	-------	1.9	.7	4.8	-------	2.2	1.8	1.2
Other	3.6	2.0	.8	2.6	-------	3.7	5.6	2.4	5.4	1.6	3.7	8.5
Lack of personal safety equipment	7.8	3.6	3.2	7.9	2.0	5.6	2.8	.6	-------	5.5	18.6	6.0
Goggles	5.9	1.5	1.6	5.8	-------	1.9	1.9	-------	-------	3.9	16.3	3.6
Other	1.9	2.1	1.6	2.1	2.0	3.7	.9	.6	-------	1.6	2.3	2.4
Hazardous arrangement	6.4	24.0	6.4	2.6	-------	8.1	1.9	9.6	1.1	7.0	3.7	7.2
Unsafely stored or piled	3.8	23.0	4.8	1.0	-------	3.8	.2	3.0	1.1	4.6	1.0	2.4
Unsafely placed	1.8	.5	.8	1.1	-------	3.1	1.2	5.4	-------	.8	2.2	2.4
Other	.8	.5	.8	.5	-------	1.2	.5	1.2	-------	1.6	.5	2.4
Poor housekeeping	4.6	6.6	.8	4.8	4.1	5.6	4.7	3.0	6.5	6.3	4.2	2.4
Lack of necessary equipment	2.1	1.0	2.4	1.6	2.0	.6	1.2	1.8	2.2	3.9	3.1	2.4
Other	1.6	1.5	-------	6.3	6.1	1.9	.7	-------	-------	-------	1.0	3.6

[1] Includes data not shown separately because of insufficient space.

[2] Number of accidents included.

TABLE 19.—Distribution of 4,170 disabling injury and medical treatment cases reported by 51 pulp and paper mills, classified by accident type and unsafe act, 1948

Accident type	Total number of accidents	Unsafe acts																	
		Using unsafe equipment or equipment unsafely					Taking unsafe position or posture					Unsafe loading, placing, etc.		Failure to secure or warn	Failure to wear proper safety equipment or clothing	Repairing (etc.) equipment moving, charged, under pressure	Operating or working at unsafe speed	Other	Unclassified; insufficient data
		Total [1]	Using equipment unsafely		Gripping objects insecurely	Taking wrong hold of objects	Total [1]	Inattention to surroundings	Inattention to footing	Exposure to moving equipment	Exposure to falling objects	Total [1]	Unsafe placing						
			Total [1]	Hand tools															
All types [1]	4,170	697	412	358	142	103	356	142	81	43	31	107	84	92	75	45	32	30	2,736
Struck by : Total	1,557	397	285	262	98	2	54	2	6	12	17	61	58	46	41	8	10	5	935
Flying or thrown objects : Total	638	15	13	11	2		10			1	2	3	3	11	40	7	6	2	544
Particles	513	6	6	5											40			1	466
Other	125	9	7	6	2		10			1	2	3	3	11		7	6	1	78
Falling objects : Total	506	133	37	29	87	2	19	1	4		14	50	48	25	1		2		276
From hands of workers	208	115	29	28	82	1	10	1	2		7	8	7	1	1		2		71
From equipment	148	11	6		2	1	4		1		3	19	18	16					98
From other sources	150	7	2	1	3		5		1		4	23	23	8					107
Hand-operated or -wielded objects	303	230	225	218	3		13			6		2	2	6					52
Mechanically powered equipment	45	7	2	2	4		5			5		1	1	1		1	1		29
Rolling objects	16	2	1	1			1				1	1	1	2					10
Other objects	49	10	7	1	2		6	1	2			4	3	1			1	3	24
Striking against : Total	607	71	38	29	17	5	147	135	5	6		5	4	2	7	6	9	7	353
Bumping into or against equipment : Total	306	57	35	26	12	3	118	110	1	6		4	3	2	1	4	2	4	114
Moving parts of powered equipment	65	4	2				10	4		6				2		4		2	43
Other parts of powered equipment	122	26	15	11	6	2	49	49				1	1				1		45
Other equipment	119	27	18	15	6	1	59	57	2			3	2		1		1	2	26
Rubbing against or striking slivers, splinters, etc	83	4			2	1													79
Stepping on objects	53						1		1			1	1						51
Striking against projecting nails, wires, etc	51						1	1							1				49
Striking against materials	42	5	2	2	2	1	9	7	2						1		2		25
Striking against other objects	72	5	1	1	1		18	17	1						4	2	5	3	35
Caught in, on, or between : Total	583	174	56	40	13	93	57		12	25	14	11	11	31	6	18	3	1	282
Moving parts of equipment : Total	245	26	11	2	1	7	15		1	14				12	5	17	2	1	167
Points-of-operation	125	6	2	2	1		6			6				2	2	5	2		102
Gears, pulleys, etc	69	16	8			6	3			3				3	3	8			36
Other parts	51	4	1			1	6		1	5				7		4		1	29
Objects being lifted or placed	128	78	2	1	6	68	12		6		4	2	2	1	1		1		33
Rolling or falling objects	74	19	3	2	6	8	11		1		10	6	6	10					28
Wheeled equipment and other objects	48	7	5			2	14		3	9		1	1	6					20
Hand tools and other objects	46	35	34	34		1						2	2			1			8
Other objects	42	9	1	1		7	5		1	2				2					26
Overexertion—due to : Total	377	19	9	8	6	2	19					19	2				1	2	317
Lifting objects	235	5			3	1	12					12	1					1	205
Pulling objects	63	3	1	1		1	2					4					1		53
Other operations	79	11	8	7	3		5					3	1					1	59
Falls—on same level : Total	294	17	14	14	3		26	2	18			4	4				1	4	242
Resulting from slips : Total	181						12		9								1		168
On floors	111						5		2										106
On other surfaces	70						7		7								1		62
Resulting from stumbles	28						8	1	7			2	2						18
Other	85	17	14	14	3		6	1	2			2	2					4	56

See footnotes at end of table.

TABLE 19.—Distribution of 4,170 disabling injury and medical treatment cases reported by 51 pulp and paper mills, classified by accident type and unsafe act, 1948—Continued

Accident type	Total number of accidents	Unsafe acts																
		Using unsafe equipment or equipment unsafely					Taking unsafe position or posture					Unsafe loading, placing, etc.		Failure to secure or warn	Failure to wear proper safety equipment or clothing	Repairing (etc.) equipment moving, charged, under pressure	Operating or working at unsafe speed	Other	Unclassified; insufficient data
		Total [1]	Using equipment unsafely		Gripping objects insecurely	Taking wrong hold of objects	Total [1]	Inattention to surroundings	Inattention to footing	Exposure to moving equipment	Exposure to falling objects	Total [1]	Unsafe placing						
			Total [1]	Hand tools															
Slips and stumbles (not falls) : Total	231						30		28			3	2	1		1	5		191
Slips : Total	182						23		23			1				1	3		154
On floors	91						5		5			1					2		83
On other surfaces	91						18		18							1	1		71
Stumbles	49						7		5			2	2	1			2		37
Inhalation, absorption : Total	193	2	1		1									7	14	3	1	8	158
Absorption resulting in : Total	163	2	1		1									3	13	3	1	8	133
Chemical burns	98	2	1		1									1	6	3	1	2	83
Dermatoses	32														1			6	25
Other injuries	33													2	6				25
Inhalation	30													4	1				25
Contact with extreme temperatures : Total	128	7	2		3		7	3	2			2	1	2	5	5			100
Hot liquids	45	1					2		2					1		3			38
Hot solids	34	2	1				4	2							5				23
Other	49	4	1		3		1	1				2	1	1		2			39
Falls—to lower levels : Total	122	5	4	3			10		7			2	2	1	1	1		2	100
From platforms, gangways, etc.	33						1							1				2	29
From ladders	24	2	1				4		4										18
From other elevations	65	3	3	3			5		3			2	2		1	1			53
Other	62	4	3	2	1		6		3					2	1	3	2	1	43
Unclassified; insufficient data	16	1				1													15

[1] Includes data not shown separately because of insufficient space.

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OTHER REPORTS ON INDUSTRIAL HAZARDS AND WORKING CONDITIONS

Annual Reports on Work Injuries: A collection of basic industrial injury data for each year, presenting national average injury-frequency and severity rates for each of the major industries in the United States. Individual establishments may evaluate their own injury records by comparison with these data.

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Quarterly and Monthly Reports on Work Injuries in Manufacturing: Press releases presenting injury-frequency rates for selected manufacturing industries, by month and by quarter. Issued monthly from January 1943 to September 1944, and quarterly thereafter. For free distribution upon request to the Bureau of Labor Statistics. Also appears in Monthly Labor Review.

Injuries and Accident Causes: Intensive studies of the frequency and severity of work injuries, the kinds of injuries, types and causes of accidents in selected major industries:

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R. 1652	Shipyard Injuries During 1943	[2]
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Other Publications

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R. 1936	Illness Absenteeism in Manufacturing Plants, 1947	[2]
R. 1931	Joint Production Committees, January 1948	[2]
R. 1928	Absenteeism and Injury Experience of Older Workers	[2]

[1] For sale by Superintendent of Documents at prices indicated. *How to order publications:* Address your order to the Superintendent of Documents, Government Printing Office, Washington 25 D. C., with remittance in check or money order. Currency is sent at sender's risk. Postage stamps not acceptable.

[2] Free upon request to: Industrial Hazards Branch, Bureau of Labor Statistics, Washington 25, D. C.