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Industrial Hygiene

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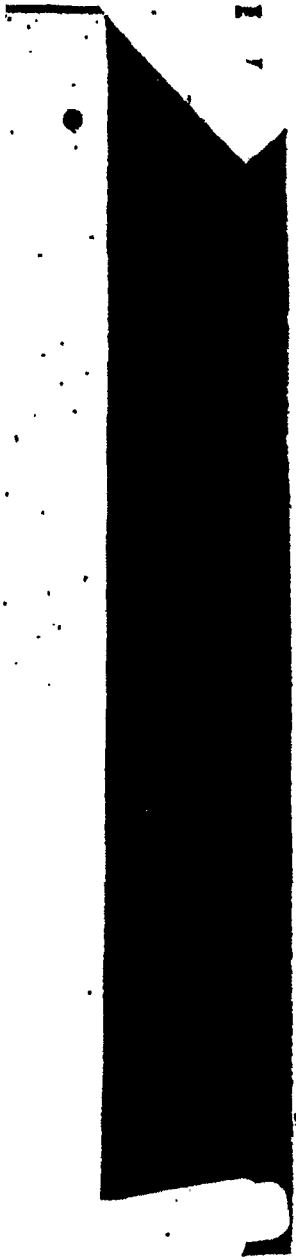

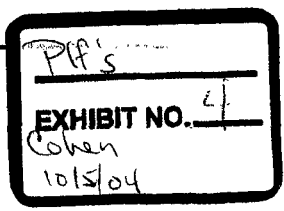
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An ideal exhaust system for removing dust in a metal polishing department.

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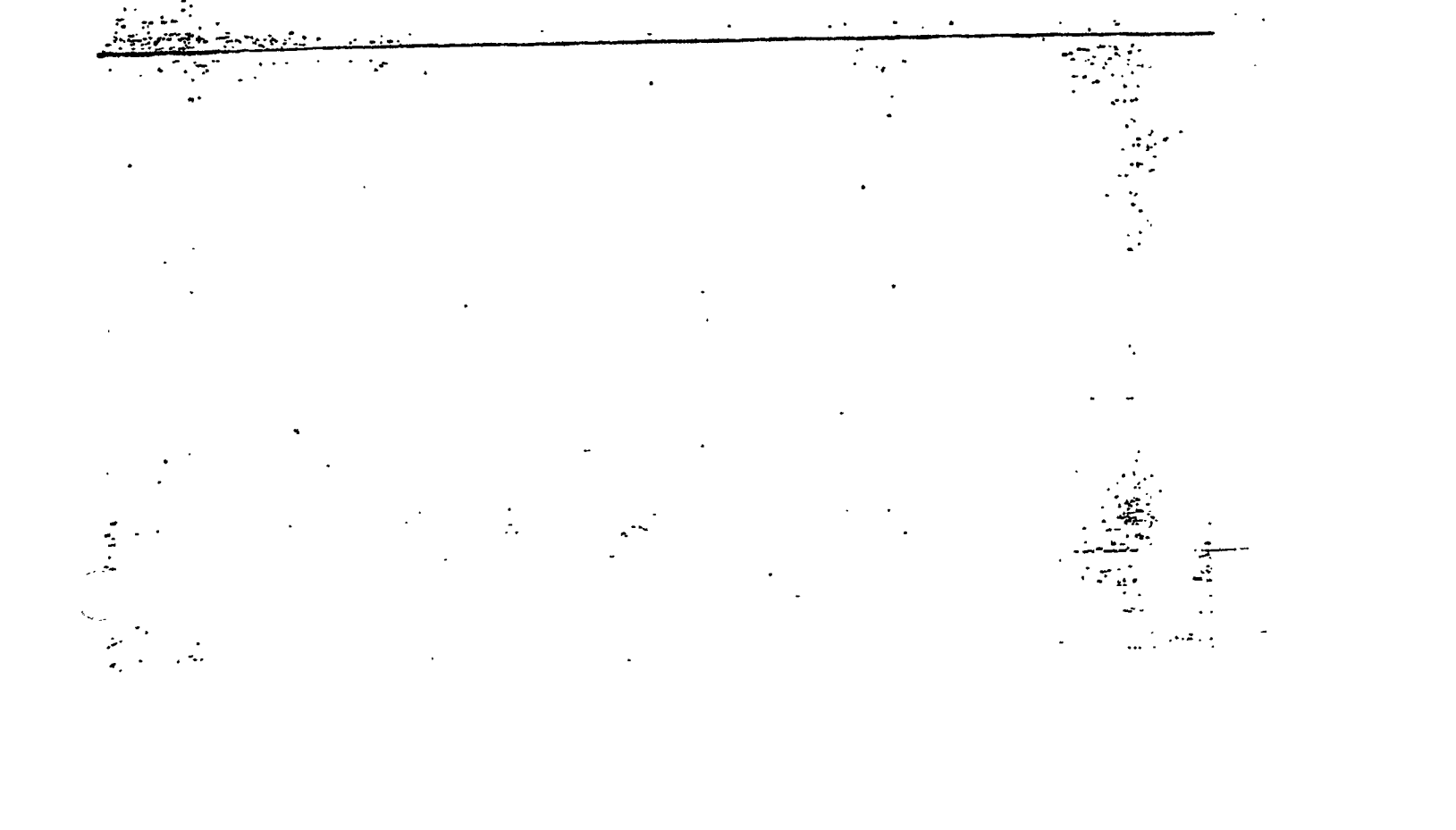


Industrial Hygiene

The Money Value of Factory Sanitation

THE physical conditions which prevail in a place where a man spends the greater part of his working time affect his outlook on life, his happiness and his ability to do useful work. A dingy workshop with bad air results in listless workers with low productivity. Bad working conditions breed resentment and distrust among workers. Often such a trifle as applying a fresh coat of white-wash to factory walls proves the means of greatly improving the spirit of everybody in the plant. Clean, moving air of the right temperature lessens fatigue and improves plant morale. By cleaning electric light fixtures and carting away rubbish, a factory manager may reverse his men's mental attitude toward their jobs, and incidentally cut down the accident rate.

By promoting better health among his workers and protecting them from occupational diseases and preventable accidents, the modern employer aims to cut down absenteeism, reduce labor turnover and decrease the amount of inferior work turned out. Safety campaigns have demonstrated that it is possible to reduce materially the number of accidents. Though the facts at hand are less spectacular, we know that health work in

industry likewise pays big dividends. Hygienic measures are not a charity, but strictly good business policy. Problems of ventilation, lighting, dust elimination, the value of the medical department, the desirability of granting rest periods, maintaining cafeterias and lunch rooms, are not impractical, academic questions. Sanitary facilities and other working conditions which promote good health among the personnel, will usually result in increased productivity that will more than cover the expenditures involved.

Medical Service

PLANT hygiene is essentially a medical question. Where the number of employees on the payroll warrants the expense, it is desirable to have the health program developed around the work of a physician or nurse. Most shops are too small, however, to employ a full time physician. They can afford only part time medical service or the occasional visits of an outside physician. To secure some of the health conservation measures that have proved valuable in large plants, some small manufacturers have availed themselves of the services of an association of industrial physicians, hygienists and safety engineers. Such an organization agrees to spend a certain fixed time in the plant, conduct sanitary and safety investigations at regular intervals and supervise the health of the workers. This procedure should give, at a small cost, the advantage of the services of a group of specialists qualified in industrial health problems. There are also interesting

and successful experiments in cooperative medical supervision which suggest another solution of the problem. Sometimes a number of small plants in the same district organize a joint medical department conveniently and centrally located, to which they all have access. Generally, the participating firms pay for this medical supervision on a pro rata basis.

First Aid Rooms

IN MODERN American factories one usually finds a suitable place set aside as a first aid and rest room. The arrangement of such rooms, their location and their supervision differ. Sometimes the first aid equipment consists merely of a cabinet or box in which there are the commoner medicines and remedies, rolls of gauze, an antiseptic, and a few instruments. The industrial codes of the different states specify very definitely just what equipment must be included in the first aid kit. The New York State Sanitary Code, for example, itemizes the instruments, drugs and dressings which must be included and the equipment which must be furnished. The minimum

A standard first aid cabinet.

medical requirement for any plant is the selection of one of the standard first aid outfits. A competent person who has been trained by a physician in applying first aid should be placed in charge of it and held responsible for its proper maintenance. He should render emergency aid only, and promptly summon a physician in case of serious accident. In buying first aid supplies, it is of course, necessary to consider the special conditions prevailing in a particular plant so as to provide the materials best suited to a given industry.

Duties of Industrial Physicians

THE duty of the industrial physician is to keep workers fit, as well as to treat cases of illness. In some plants, he conducts the physical examination of all applicants for employment and rejects those suffering from any disease which might prove a menace to their fellows. He notes physical disabilities and recommends to those in charge of hiring workers, the kind of work the applicant is best able to do without injury. He also may make a periodic examination of all employees so that physical weaknesses and slight illnesses may be discovered and treatment provided. This type of preventive medicine should be strongly encouraged.

The industrial physician cares for all accident cases from the time of injury to the date of recovery, taking particular precautions to avert the danger of wound infection. He likewise gives emergency treatment for any of the

A well-equipped dispensary. Note the good light, unit tables and simplicity of arrangement.

minor illnesses which occur during working hours. He supervises all cases of serious illness and sees that sick employees receive proper attention. It is his duty to recognize immediately cases of communicable disease and check their spread by enforcing isolation. Aided by the nursing staff, he should instruct employees in the principles of healthful living and personal hygiene.

Duties of Industrial Nurses

IN LARGE plants the industrial nurse works under the supervision of the physician and aids him in the dispensary, writes up histories and assists in the routine physical examinations by taking weights and measurements. Sometimes she writes up the records and attends to the clerical work of the office. When the physician is absent, she gives simple treatment, being careful to refer all serious cases to the doctor. Unfortunately, some firms who do not employ a physician consider that they have done all that is necessary in engaging a nurse and in placing her in charge of the medical work. Nurses should work only under the direction of a physician who diagnoses cases, orders treatment and supplies standing orders for use in his absence. Though the nurse is careful (as she should be) to make no diagnoses, she often can discover workers in need of medical attention and encourage them to get expert advice and treatment. Sometimes she does important educational work by lecturing to employees on specific health problems and personal hygiene.

Personality of Industrial Physicians and Nurses

THE success of medical work in industry is largely dependent on the personality of the doctors and nurses. The industrial physician must have a creative attitude toward his job, realizing that his mission is to prevent disease and that this phase of his work is as important as his skill in caring for the sick. It is desirable for both industrial physicians and nurses to receive some special training for their work. In growing numbers, medical colleges and schools for nurses are giving courses and training in industrial hygiene. Such courses should give some idea of the principles of factory sanitation and the special industrial hazards which must be guarded against, as well as the best method of treating accident cases so that the least possible working time shall be lost. Nurses also will find helpful a knowledge of food values, family budgeting, psychology and the organization of clubs and health classes.

Both physician and nurse must have high ideals toward their work and be imbued with a spirit of service. The doctor must have a sympathetic understanding of difficulties which confront the workers who often are ignorant of American customs and standards of living. In this way he may well be a harmonizing influence in the plant and render valuable service through promoting better industrial relations. He must convince the men that health supervision results in their increased efficiency and consequent larger

earning capacity, and that his work is done in good faith and to benefit them. On the other hand, the employer must have faith that the medical department is supplying him with healthy and efficient workmen who will increase production. Thus a well administered medical department rests for its success upon the sound principle of fair dealing.

Factory Hygiene

FACTORY sanitation includes all measures which preserve the health of workers and prevent disease. Practically, however, its scope is limited to maintaining cleanliness; providing suitable ventilation and proper lighting; supplying pure drinking water; giving adequate toilet, washing and dressing facilities; and properly disposing of refuse and wastes.

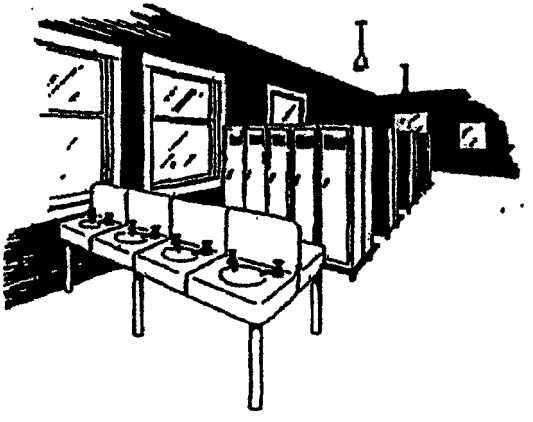
General Cleanliness

NOTHING is so often neglected by both employers and employees as the maintenance of general cleanliness in the plant. Yet that directly influences the efficiency and well-being of workers to a very marked degree. Dust-covered ceilings, floors, fixtures and machinery present a disorderly appearance and incidentally reduce the amount of light from windows and lighting equipment. Disorderly work-rooms produce slovenly habits of work in much the same way as an untidy household produces uncouth habits of living. Dirt not only looks unsightly, but interferes with the smooth running of the shop. A dis-

orderly work-room encourages unhygienic practices. Refuse usually will not be thrown on a clean floor, but certainly will be added to the litter which clutters up unswept corners. Workers cannot be expected to have pride in keeping work places ship-shape if no provision is made by the management for the removal of dirt, and no regular attention is paid to the appearance of the shop.

Washing Facilities

IN ADDITION to keeping work places clean, adequate washing facilities should be provided. The number of wash basins and faucets of water depends somewhat on the industry. Some industrial codes require, as a general rule, one wash basin for every fifteen employees. In dusty and hazardous trades, a larger number is necessary. Where



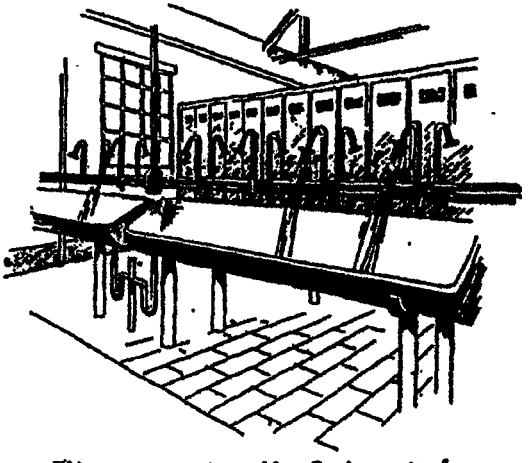
A washing and locker room equipped with individual basins and lockers.

the worker is exposed to great heat, excessive dust, or contact with poisonous materials, or where he handles food products, shower baths should be available in addition to the ordinary washing facilities. Sinks and wash basins should be made of vitrified glazed earthenware or enameled iron. The faucet should be of a type that will permit the employee to wash in a flowing stream of water. Soap, hot and cold water and individual or paper towels should be provided. The use of a common towel is to be discouraged, as this practise is often the source of infection. Wash-rooms should be well lighted, heated and ventilated and kept scrupulously clean.

Use of Washing Facilities

AN ACTIVE campaign may often be needed to encourage the use of the washing facilities provided. It is always wise to wash up before meals, but in industries where poisons (such as arsenic, lead, mercury, etc.) are handled, particular pains must be taken to enforce washing regulations. Though recently there has been a decrease in the number of cases of lead poisoning, workers in plants manufacturing white lead for paint, pottery, tiles, porcelain, enameled sanitary ware and storage batteries, and in the painting trades, are still exposed to the hazards of lead poisoning. This occupational disease can be further reduced by enforcing a few simple rules. All traces of poison which adhere to the clothing, hands and other exposed parts

of the body must be washed off carefully before eating, so that the danger of swallowing poison may be eliminated. For example, the



This arrangement provides flowing water for the worker to wash in.

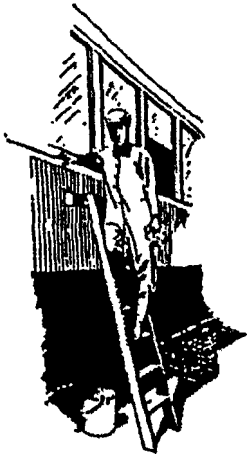
Pullman car shops inaugurated compulsory and supervised washing up, by ringing a bell ten minutes before the noon hour and requiring all employees to wash and scrub their hands. This wash-up system reduced lead poisoning from 77 cases in 1911 to none in 1912.*

Working Clothes

IN FACTORIES where poisonous substances are handled and where unusually heavy and arduous work is done, workers generally change their street clothes for

*See also page 20 following for a further discussion of the poison hazard

overalls or a suitable working uniform. It is especially necessary to change the working uniform before the lunch hour in plants where poisons are handled. In a foundry the workers need special shoes and clothing in order to protect their bodies from the molten metal they are pouring.



A suitable working uniform.

Suitable uniforms should also be worn in those jobs where there is danger of catching the clothing in moving machinery. When the work being done is necessarily dirty or dusty, a work uniform saves both the clothing and self-respect of the worker. A special uniform is necessary to protect the consumer wherever foodstuffs are handled. In many cases the employer provides the uniforms and sees that they are kept clean. He should do so, if he wishes to make their use compulsory.

Dressing and Locker Rooms

DRESSING rooms are necessary if wearing special working clothes is to be encouraged. The dressing rooms must be large enough to prevent crowding, expedite changes of clothing and afford sufficient privacy. Dressing rooms for the two sexes should be

separated and if possible, located in different parts of the floor. The industrial codes of the different states specify the amount of floor space, the temperature, ventilation and amount of lighting which must be provided. It is desirable that every dressing room have one window, be properly lighted and kept clean and tidy.

Proper provision should be made for hanging the clothes of employees in a dry, clean space. If possible, individual well-ventilated lockers should be supplied. In factories where only clean work is performed, separate clothes hooks amply spaced may be used instead of lockers. Some factories provide steel lockers divided into two parts, one for the working and the other for street clothes.

There are a number of lockers on the market which are good and comparatively cheap. Still another variation in taking care of employees' clothing is the overhead hanger which airs and dries the clothing. The street clothes are kept in lockers and the working clothes are suspended from the ceiling and raised and lowered by means of a chain and pulley. The chain should have a locking arrangement so that the clothes cannot be lowered unless the locker is opened.

Toilets

THE best location for toilet rooms is adjoining the washing and locker rooms. Most industrial and sanitary codes demand separate water closet compartments for the two sexes. If possible, they should be located

in different parts of the building. Where it is necessary to place them together, they should be separated by solid partitions extending from floor to ceiling. In large plants it is necessary to provide toilet rooms throughout the works and have a sufficient number convenient and easy of access to the workers. One closet for every twenty persons generally suffices. Where a large number of men is employed, there should be, in addition, an adequate number of urinals suitably enclosed. Constipation, with the many unpleasant and injurious complications which it brings, often results from providing inadequate and unsanitary toilet facilities.

Toilets should be properly lighted and ventilated and above all, kept scrupulously clean. Hot water is highly efficient as a disinfectant. To facilitate cleaning and to provide means for flushing out the rooms, a hose connection with the hot water supply lines should be provided in toilet, washing and locker rooms. If a disinfectant is used, it is better to add it directly to the washing water; but no disinfectant should be permitted to replace the frequent use of soap and water. The United States Public Health Service has issued two bulletins (Hygienic Laboratory Bulletin No. 82 and Public Health Bulletin No. 42) which give much valuable information on various commercial disinfectants and their usage.

Floors of tile or concrete construction are best. The floor and side walls should be made of material impervious to moisture and possessing a smooth surface. Asphalt, non-

absorbent cement, tile, glazed brick or other waterproof material may be chosen. The walls and partitions should be of material that can be easily cleaned and light in color so as to increase the illumination in the room. Water closets of the individual bowl type are recommended and should be made of white vitreous china or porcelain. The seat of each water closet should be made of wood or other non-heat-absorbing material coated with varnish or waterproof paint. For sanitary reasons, it is recommended that the bowl be of the extended lip type and that the seat be open front and back.

There is quite a difference of opinion regarding the best flush valve arrangement. In some factories, toilets are automatically flushed at hour intervals. Sometimes this flush is operated by the opening or closing of the door of each compartment or by the raising of the seat of the closet. These contrivances are installed so that it is impossible for workers to neglect pulling the chain or lever of the flushing tank. But at all events, every water closet or group of water closets should be flushed regularly and the discharge must be of sufficient force to clean the bowl at each flushing.

Drinking Water

A PURE, cool and plentiful supply of drinking water is essential to health. Drinking sufficient water improves the digestive processes, aids assimilation of food and lessens fatigue because it facilitates the removal

of those poisonous wastes produced in the system with the expenditure of energy. Few people drink the amount of water which physiologists agree is necessary to keep the body in a thoroughly healthy condition. Workers should be encouraged to drink more water and educated in the value of so doing. Hence, the drinking supply must be conveniently located so that too much time will not be wasted each time a drink is wanted.

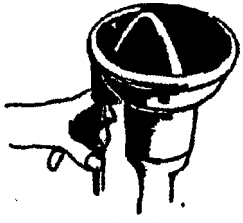
The water supply must be wholesome and its source should be carefully chosen. Many diseases, such as typhoid, diarrhea, dysentery, and other intestinal disturbances arise from drinking impure water. Wherever possible the water should be drawn from an approved and safe city supply. If the plant has its own system, frequent chemical and bacteriological examinations should be made. If the water available is not suitable for drinking purposes it must be purified by sterilization or filtration.

The drinking fountain in use.

Often the plant uses for industrial purposes water drawn from adjacent rivers, canals, or lakes. In many cases, this water is not safe for drinking and great care must then be taken to keep the two supplies separate. Employees must be cautioned to drink only the water provided for that pur-

pose, as many typhoid epidemics in plants have been traced to their carelessness in drinking impure water.

A temperature between 45 and 50 degrees is the best for drinking water. The most satisfactory system is one where all drinking water passes through a sanitary refrigerating or cooling plant to the supply pipes. The refrigerator equipment usually consists of a storage tank containing a pipe coil in which liquid ammonia is allowed to vaporize. Water coolers requiring ice should be used only in plants of comparatively small size. If water coolers are used, ice should not be placed in direct contact with drinking water. A refrigerating plant eliminates the necessity of keeping the cooler supplied with ice; prevents contamination from ice; and keeps the drinking water at a constant and desirable temperature. In the long run it will prove far more economical than the old-fashioned ice cooler.



A hygienic drinking fountain.

After making sure the water is pure and wholesome, the next concern is to provide drinking fountains of proper design. Many states prohibit the use of common drinking cups and require either individual cups or a sanitary drinking fountain. If the fountain is correctly designed, it is more satisfactory and cheaper than the individual cup. It has been found by careful experiment that the

best type of fountain is one discharging the water at an angle of 15 degrees instead of vertically from the discharge pipe. This fountain retains no germ in the stream or in the outlet and prevents lip contact as well as droplet infection.

Ventilation

RECENT studies have shown that a poorly ventilated room reacts unfavorably upon the health and efficiency of the workers in it. Lassitude and other ill effects of faulty ventilation are difficult to estimate directly, but an appreciation of their extent may be arrived at indirectly from statistics of output, accidents and sickness rates in well and badly ventilated factories. It has been supposed that the evils of poor ventilation were due to the reduction of oxygen, an increase of carbon dioxide, the presence of volatile substances given off in perspiration and to bacteria carried by the air.

In industrial processes which involve the generation of poisonous fumes or dust, the chemical composition of the atmosphere is important. But it is now generally agreed that the chemical condition of the atmosphere in the ordinary plant has comparatively slight effect upon working capacity and bodily condition and that the air does not carry bacteria to any extent. It is the temperature, humidity, dust content, and especially the motion of the air, which determine whether the air of the work-room is good or bad. The cause of discomfort in the ordinary badly ventilated room is heat and stagnation, com-

bined in many cases, with excess humidity—and it is these conditions which should be controlled.

The desirable temperature for a work-room will vary from 60 to 65 degrees Fahrenheit for work involving much physical exertion, to between 68 degrees and 70 degrees for other work. Ordinarily, a temperature of 68 degrees produces the maximum efficiency and is the most comfortable for workers. A higher temperature increases the heart rate. It affects the body temperature and blood pressure, increases the rate of respiration and the susceptibility to respiratory disease and substantially reduces efficiency. If the temperature is increased to 75 degrees Fahrenheit, there is a decrease of 15 per cent. in the amount of heavy physical work performed; the decrease amounts to 28 per cent. at a temperature of 86 degrees.

The first step in factory ventilation is a definite knowledge of existing conditions. A thermometer should be installed in every factory work-room, and periodic examination of this thermometer should be an essential part of the duty of the foreman. Something should be done when the temperature exceeds 68 degrees. Over-heating often is due, not to a defect in the ventilation system, but to unintelligent use of it. Generally, the temperature can be regulated by simply turning off the heat. Such supervision not only would contribute to the health of the worker, but also would reduce the coal bills materially. Opening all the windows before working hours and during the noon recess and between

working-shifts will often secure good working conditions. Where the room is large and crowded, it may be necessary to adopt the three devices which have been so useful in school-room ventilation:

1. Location of radiation units beneath the windows to temper the incoming air.

2. Admission of air over slanting window-boards to avoid drafts.

3. Provision of a gravity exhaust duct for the removal of vitiated air near the ceiling.

But the importance of maintaining the temperature below 68 degrees by the regulation of heat sources and the intelligent manipulations of windows, cannot be overemphasized.

Fifty per cent. humidity of the air is a desirable moisture content for the ordinary room at a temperature of 68 degrees. It is always safer, however, to run below this figure rather than above it. Increased humidity aggravates the effects of increased temperature. A desirable condition, though one of less importance, is the maintenance of a carbon dioxide content of less than ten parts in 10,000. Where a large number of men is employed, the amount of air space for each workman is an important consideration. The risk of infection with tuberculosis and other diseases is increased when the workroom is overcrowded. Three thousand cubic feet of air an hour for each individual is the average

requirement. The air in the room should be changed from three to five times an hour.

Besides maintaining the purity of the air, it is necessary to see that it is kept in motion. Fresh air must be supplied constantly at the same time that the unclean air is being removed. There are two methods of ventilation: natural and mechanical. Natural ventilation comes from the ordinary openings in a building, such as windows, doors, transoms, air and elevator shafts, and the pores, cracks and crevices that are always present in the walls. Even when all openings in a building are apparently closed, there are currents of air flowing through the pores of the building material and the crevices of the doors and window panes. But the air supplied in this way is not sufficient to ventilate a room. Windows, which in early days were installed in buildings for lighting purposes only, now play the most important part in natural ventilation. The best type of window is pivoted at the center to allow the entire window space to be utilized. However, there are two serious objections to the ventilation supplied by natural methods: first, in spite of the various deflecting devices which are used, it is very difficult to prevent drafts; second, it is easy for any workman to tamper with the ventilation of the room. It is, therefore, essential to appoint a competent person to regulate the windows.

To increase the ventilation in rooms, special openings are made. These inlets and outlets should be as far apart as possible and ample

in area. There are many devices and appliances for forcing out stale air and letting in fresh air, such as tubes, shafts, ducts and fans specially constructed for ventilating purposes.

Such methods are generally adequate in small factories. But in work-shops where a large number of workers is employed and where injurious dusts, gases and fumes are produced, mechanical ventilation or special machinery for the movement of air must be resorted to. Two types of ventilating systems are used: the vacuum system which mechanically exhausts air from the room, and the plenum or propulsion system, where the air is forcibly driven and propelled into the room by means of fans.

The exhaust system is the simplest; but it is used chiefly either in places where local exhaust is necessary for dust, gases and fumes, or in large rooms which are not occupied by too many persons. The plenum system is usually installed in establishments where a large supply of air must be introduced from some remote source and where provision must be made for the modification of the incoming air either by cleaning, filtering or washing, or by tempering and humidifying. Even very difficult ventilation problems can be solved by competent engineers with complete success. Where unusually complicated systems are required, it is well to call in expert advice. If plenum ventilation is needed at all, it requires expert design in order to be efficient.

How to Prevent Injury from Dust and Gases

DUST is the great enemy of the workman. The dust and gases liberated in the course of many industrial processes, if not properly removed, give rise to chronic lung affections and a variety of acute and chronic irritations. The kinds of dust vary greatly in their hygienic significance. Some are poisonous and some act as mechanical irritants. Some of the principal poisonous dusts found in industry are lead, mercury, arsenic, and manganese.

The dusts which act by mechanical irritation are especially the hard irregular particles with sharp edges from iron, steel and other metals; rock dusts, such as granite or marble; while those from coal, chalk and plaster of Paris are less irritating. Probably the most harmful of the dusts (with the exception of poisonous dusts) are emery dust, which is composed of exceedingly hard sharp particles; sandstone dust, to which workers are subject in surfacing, polishing and crushing stone, sandblasting, etc.; and silica which produces serious lung disease in a comparatively short time. Dust may be inhaled or ingested or affect the skin, eyes and ear canals. Some poisonous dusts make important changes in the blood or attack the bones or nervous system. Irritating fumes act locally upon the tissues or the mucous membrane of the throat, nose and lungs.

The hazards arising from the presence of

these dusts and gases may be eliminated, in some cases, by using wet instead of dry processes which keep the dust from rising and filling the atmosphere. The installation of closed machinery methods will confine the dust producing processes and allow them to be regulated from the outside. Sometimes isolating the operation where dust or fumes are generated to a separate room is desirable. A mechanical exhaust system which removes the dust at the point of origin often is used and is effective just as long as the system

Exhaust system in an electroplating room.

remains in good working order. Sometimes it is sufficient for the workers to wear respirators, helmets or other protective devices. But usually these are uncomfortable and the men refuse to wear them.

In many cases it may be necessary to com-

bine several of these measures in order to prevent effectively the inhalation of dust by the worker. When the fumes and gases are lighter than the air, an ordinary chimney flue arrangement may be all that is necessary for their proper disposal. In other cases more elaborate apparatus is required. The details of its construction must be worked out separately for each individual case. At all events, wherever poisons are used and injurious dusts and gases are present, it is essential that every possible means be employed to lessen the hazard to which the workers are exposed.

Extreme heat cannot be eliminated from certain occupations which require men to work near blazing furnaces. In iron and steel foundries, smelters and chemical factories, special measures are necessary to mitigate this heat hazard. One useful device is the water-cooled furnace door. Shields may be employed to deflect the heat away from the work-room. Cold air helps materially to reduce the temperature of the work-room. The air should be kept in active motion and electric fans should be employed if other methods cannot be applied. The worker should allow his body to cool off gradually and change into fresh clothing after the completion of the day's work. Respiratory diseases, especially pneumonia, are unduly frequent among workers exposed to high degrees of heat and, therefore, such precautionary measures are justified. In those plants where heat and humidity far above the health limit are present, special attention must be paid

to the health of workers and they should have the benefit of a physical examination at frequent intervals.

Lighting

LIGHTING equipment is still far from adequate in most American plants, although much progress is being made in lighting improvements. Increase in both the quality and quantity of production and, inversely, decrease in the amount of spoilt work, follows improvement in lighting equipment. Better lighting systems increased output 2 per cent. in steel mills and 10 per cent. in shoe and textile factories where the work is more exacting. In one steel plant, night output increased 10 per cent. after the installation of an effective lighting system, dropped back again when the new lamps were taken out, and returned to the higher rate when the better system was restored.

Examination of the eyesight of groups of workers in various industries disclosed that a very large number suffers from defective vision. This impairment lowers their efficiency, causes eye-strain and consequent headaches, fatigue and ill health. Adequate illumination decreases the probability of accidents. According to the National Safety Council, a careful analysis of 91,000 accidents shows that about 24 per cent. were due wholly or in part to poor lighting. The curve showing the seasonal distribution of accidents rises during the winter months when artificial lighting is more often used.

One of the most prevalent types of accident —that of persons falling—is particularly associated with artificial lighting. The greater the risk of accident in any operation, the higher should be the standard of lighting. Insurance companies, realizing this fact, increase the rates of premium in factories where the lighting is defective.

Daylight is the best form of lighting. The essentials of daylight illumination as summarized by the United States Public Health Service are that:

1. The amount of light admitted to the interior should be as large as possible.

2. The light should reach the center of the room.

3. The distribution of light upon the working planes should be as uniform as possible.

4. The light should fall upon working planes from a proper direction.

5. The walls and trim of the room should be of such color and surface as to absorb little light, white being the preferable color.

6. Manufacturing and other equipment should be so disposed as to avoid casting extensive local shadows.

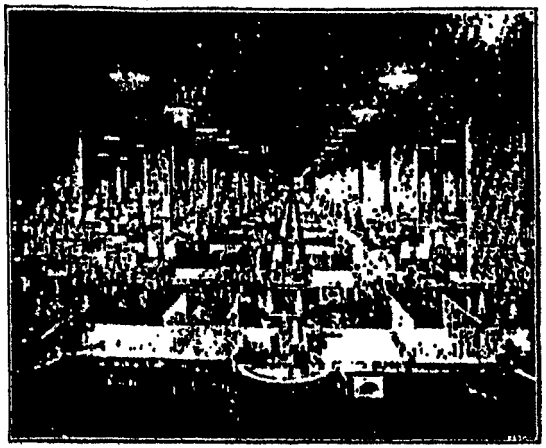
Roof lighting is preferable to side lighting, but is possible only in one story buildings, or on the top floor of factories. Side lighting is the only method available in many plants. Windows should reach the ceiling, as light from the top of the window penetrates furthest. For the same reason if blinds are necessary to keep direct sunlight off workers,

Good lighting adds to the attractiveness of a store and increases sales by displaying goods more effectively.

they should roll upwards and not downwards. The minimum ratio of floor space to window area is generally specified as four or five to one for factories, and seven or ten to one for office buildings. The size of the window space varies with the kind of work to be done and the amount of direct light which reaches the windows. Dirty windows greatly diminish the amount of light transmitted. The necessity for frequently cleaning windows, both inside and outside, cannot be too strongly emphasized. Failure to wash the windows often enough is a poor economy, as it necessitates the increased use of artificial lighting.

Too much daylight may be as bad as too little, if it is glaring and trying to the eyes of the workers. Ribbed, roughened or prism glass is useful for diffusing light and preventing glare in those cases where the daylight strikes the windows at an oblique angle, and where there is a consequent concentration of light in a narrow band near the windows and an absence of it in the center of the room.

The quality of artificial light should approach as nearly as possible to that of sunlight. The most common source of artificial light is obtained from electric or mercury vapor light, though various types of gas mantles are also used. But most factories prefer the Tungsten bulb and a proper reflector as a standard unit. Important items of artificial lighting are intensity, distribution and absence of glare. Lamps should be so placed that sharp shadows are avoided. Not only must the supply and quality of light be adequate, but it must be so arranged as to fall



Manufacturing processes can be carried on effectively at night under lighting conditions such as are shown here.

on the work properly. Machines and work benches should be placed so that they will receive proper illumination, but at the same time not interfere with the distribution of light for others.

The type, size and placing of lamps should be determined with especial reference to the height of the ceiling and the class of work being performed. Where lights are placed low they should be covered with a reflector or shade of such a size and shape that no beams from the light can fall directly upon the eyes of the worker. Glare and eye-strain are thus avoided. The development of new and improved types of lights, in many sizes, makes it possible to secure satisfactory and adequate illumination in any industry and under varying conditions. In general, the overhead system of lighting should be employed wherever possible, thereby avoiding the use of individual lamps except for special cases. However, carefully shaded individual lamps are generally used for drafting, fine hand or fine machine work.

Switches should be arranged in such a way that the lights in the dark parts of the room can be turned on separately as daylight fails, without necessarily turning on the lights over the whole floor.

The National Safety Council has recommended the following standards of lighting:

	FOOT CANDLES*
Roadways and yard thoroughfares	⅛ to ¼
Storage spaces	½ to 1
Stairways, passageways, aisles	1 to 2

	FOOT CANDLES*
Toilets and washrooms.....	1½ to 3
Rough manufacturing such as rough machining, rough assembling, rough bench work, foundry floor work.....	2 to 4
Rough manufacturing involving closer discrimination of detail.	3 to 6
Fine manufacturing such as fine lathe work, pattern and tool making, light colored textiles.	4 to 8
Special cases of fine work, such as watch making, engraving, drafting dark colored textiles.	10 to 15
Office work such as accounting, typewriting, etc.....	4 to 8

*Illumination is measured by the foot candle. One-foot candle is the amount of light produced by one standard candle on a vertical screen, one foot from this source, and so placed that the light rays strike the surface at right angles.

The necessity for washing the windows has been mentioned. It is equally important to keep all parts of the lighting equipment clean. An effective lighting installation may be rendered worthless, if it is not properly maintained. Lamps and reflectors must be washed frequently. Burnt out lamps must be replaced as soon as they lose their power. Lighting efficiency has been found to decrease as much as 50 per cent. when this matter is neglected.

Bibliography

THE science of industrial hygiene is not a new one. For many years students of industrial questions have been endeavoring to discover the factors which influence productivity and the effect of occupation upon the health and well-being of workers. A large literature already exists which contains valuable information on the problems so vital to the best interests of the employer and the employee. In this brief summary it would be impossible to do more than touch upon a few of the underlying considerations which result in better hygienic practices in the workshop. Other matters, such as accident prevention and safety campaigns; fatigue and rest periods; recreation; cafeterias and lunch rooms; and other welfare activities, are discussed in other reports. For specific data on any special phase of the question, the following books are offered as references. There are many other excellent studies; but these probably will be found sufficient to give a general resumé of the subject:

Health Service in Industry—*W. Irving Clark, Jr.*—Macmillan Company, New York, 1922.

The Human Factor in Industry—*Lee K. Frankel and Alexander Fleisher*—Macmillan Company, New York, 1920.

The Modern Factory—*George M. Price*—John Wiley & Sons, New York, 1914.

Safe Practices—Shop Lighting—National Safety Council, Bulletin No. 22.

Safe Practices—Drinking Water, Wash and Locker Rooms and Toilet Facilities—National Safety Council, Bulletin No. 27.

Safe Practices—Industrial Ventilation—National Safety Council, Bulletin No. 37.

Safe Practices—Exhaust Systems—National Safety Council, Bulletin No. 32.

Disinfectants; Their Use and Application in the Prevention of Communicable Diseases—*Thomas B. McClintic*—United States Public Health Service, Bulletin No. 42, 1910 (Revised 1917).

Method of Standardizing Disinfectants With and Without Organic Matter. Determination of the Phenol Coefficient of Some Commercial Disinfectants—*John F. Anderson and Thomas B. McClintic*—United States Public Health Service, Hygienic Laboratory, Bulletin No. 82, 1912.

Occupation Hazards and Diagnostic Signs—*Louis I. Dublin and Philip Leiboff*—United States Bureau of Labor Statistics, Bulletin No. 306, Washington, April, 1922.

Waste in Industry—*Report of the Committee on Elimination of Waste in Industry of the Federated American Engineering Societies*—McGraw-Hill Book Company, New York, 1921.

Chapter 15—Health of Industrial Workers, p. 342-373.
" 16—Eye Conservation, p. 374-390.

Industrial Hygiene and Medicine—*E. W. Hope; W. Hanna and C. O. Stallybrass*—Bailliere Tindall & Cox, London, 1923.

Chapter 3—General Hygienic Considerations, p. 45-89
" 4—Industrial Poisonings and Their Effects, p. 90-194.
" 5—Dust as a Cause of Disease, p. 195-277.
" 10—Industrial Welfare; Medical Supervision, p. 596-633.

Preventive Medicine and Hygiene—*Milton J. Rosenau*—D. Appleton & Company, New York, 1921.

Section 12—Industrial Hygiene and Diseases of Occupation, p. 1279-1324.

Industrial Medicine and Surgery—*Henry E. Mock*—W. B Saunders Company, Philadelphia, 1919.

The Health of the Industrial Worker—*Edgar L. Collis* and *Major Greenwood*—J. & A. Churchill, London, 1921.

Industrial Fatigue and Efficiency—*H. M. Vernon*—E. P. Dutton & Company, New York, 1921.

Ventilation—*Report of the New York State Commission on Ventilation*—E. P. Dutton & Company, New York, 1923.

Industrial Nursing—*Florence Swift Wright*—Macmillan Company, New York, 1919.

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