marked tremors, paralysis, and psychical changes. The tremors and paralyses are noticeable especially in the muscles of the face, hands, and arms. Melancholy, depression, loss of memory, and hallucinations are some of the psychic forms. Kussmaul has shown that mercurialism acts very unfavorably upon women, predisposing to abortions and to diseased conditions of the infants.

Phosphorus.—The danger of phosphorus poisoning is almost entirely restricted to the manufacture of matches from yellow phosphorus. The making of matches from red phosphorus (safety matches) is not accompanied by any dangers. The principal effect of phosphorus is its action on periosteum and bones, the maxillary bones being the most easily affected. A prolonged exposure to the action of phosphorus is necessary before the specific effects of it are noticeable. Some writers claim that phosphorus has no effect on healthy periosteum and bone and that only those who suffer from caries of the teeth and other affections exposing the periosteum of bones to the phosphorus fumes are affected. The disease manifests itself in necrosis and sequestration of the affected bone or of that portion of it which is diseased. The number of cases of phophorus poisoning in the United States is not large. Sweden is the country where most of the match factories are located, and where phosphorus poisoning is most frequently met.

Copper and Brass.—Copper is a metal which is found in a pure state, and which is also procured from various ores. Brass is an alloy of copper and zinc. The mining of copper and the manufacture of copper vessels, etc., are not considered as dangerous as the manufacture of brass and brass articles. It has been said that workers in copper have often found that their hair, urine, and skin turn green. The salts of copper are more poisonous than the metal. Arlidge thought that inhalation of copper dust produces the "copper colic," which is a form of digestive disturbance characterized by pain, purging, vomiting, and prostration. This is denied, however, by later investigators, who assert that the symptoms are due to a mixture of the carbonate of copper and lead.

Workers in brass-smelting and the manufacture of brass articles are subject to inhalation of brass dust and fumes. A general catarrhal condition of the respiratory passages and gastro-intestinal tract results from exposure to brass dust. What is known as "brassmen's ague," which is characterized by chills, fever, cephalalgia, nausea, depression, prostration, and collapse, is thought to be due more to the zinc in the brass than to the copper.

Noxious Gases and Fumes.—The occupations in which perceptible quantities of dust or definite poisonous substances are produced are few in comparison with the numerous industries in the processes of which noxious gases and fumes are evolved. The industrial processes in which chemical agents and gases are produced which, when absorbed or inhaled, may become dangerous to health, are so manifold and diverse that it is absolutely impossible to give even a brief description of them. Nor is it always possible to trace the harm done to health in these chemical industries to any one of the elements or gases prevalent in the process, for in most of these industries various and complicated processes are being simultaneously carried on, and the workers may be exposed to a number of agents and gases at the same time or successively. If we take, as an example the coal-tar color industry, there are several dozens of various agents produced, either together or as by-products, and each of them may be more or less injurious to health; and it is exceedingly difficult sometimes to determine which of them has produced the most harm in the case of any particular individual. So widely do chemical manufactures permeate the whole range of human industries that there is hardly an article or substance made in which chemical processes of some kind do not take place.

Some of the principal agents and gases evolved in chemical trades are the following: Sulphur and its compounds; carbon and its compounds; sodium, sodium chloride, chlorine gas; potassium and its salts; ammonia, ultramarine, carbon bisulphide, dynamite, nitroglycerin and other explosives; chromium, alum, iron and its oxides; lead and its salts; arsenic, copper, zinc, illuminating gas, coal tar and its products, nitrobenzol, the various drugs, india-rubber, turpentine, cyanogen compounds, and many others too numerous to mention.

Most of these agents are used, in one or another form, singly or in combination, in most of the human industries and arts; and many of them are also toxic to a large degree, and injuriously affect the health of those engaged in their production and in handling them.

The effects of the work with noxious agents and gases are either acute or chronic, and the dangers are from (1) the toxicity of the substances; (2) the danger of explosions, burns, and corrosions; and (3) the excessive temperatures which are necessary in most of the chemical processes. The mode of introduction of these noxious agents into the system is somewhat different from that of the dusts produced in other trades; and the effects are also somewhat different. While the inhalation of dust acts chiefly upon the respiratory system, the gases and other noxious agents of the chemical industries have each their own effect, each having specific action, but mostly of a toxic character. Moreover, while dusts affect the human system only after long exposure and continuous and prolonged inhalation, the effects of gases and chemical agents are produced after comparatively short exposures. Again, while the effects of dust inhalations may always be seen on the respiratory system, and at times pathologically demonstrated by the presence of the dust in the lung tissue, the effects of toxic agents and gases cannot, in most cases, be demonstrated, and, if at all, only in the blood, by chemical and spectroscopic examinations.

Roth cites Austrian statistics of mortality and morbility among chemical workers. He found the mortality to be 7 per 1,000. The diseases with which they were affected were distributed as follows: 25.7 per cent. for burns, contusions, and the like accidents; 17.9 per cent. for affections of the respiratory system; 14.7 per cent. for disorders of the digestive tract; 10.8 per cent. for diseases of the skin, and 10.5 per cent. for general constitutional diseases.

Prophylaxis.

Having briefly examined the various dangers of different trades, we now come to the most important phase of our subject, that of prophylaxis; the most important, for, after all, the aim and purpose of hygiene in general, and industrial hygiene in particular, is the prevention of disease and preservation of life. On a closer study of industrial conditions we find that many, if not most, of the dangerous elements in trades are preventable, and that there is no need for the terrible waste of health and vast destruction of life prevailing in modern industries, as shown in the mortality and morbility statistics.

In the endeavor to improve industrial conditions, and prevent unnecessary suffering in the dangerous trades, medicine and legislation are allied: the one to study and expound the rules of health, the other to enforce the laws based on scientific hygiene. Unfortunately, the ignorance of the workingmen and the cupidity and negligence of employers are the two stumbling-blocks to the general acceptance of the better laws of health.

In discussing the hygiene of occupations we propose to consider the subject under two heads—General Prophylaxis and Special Prophylaxis.

General Prophylaxis.—The first personal requirement for preventing the evil influence of occupation on health is the proper selection of a trade; this is commonly done by natural selection, or more frequently by accident; yet it is very important that certain trades be followed only by the best physically endowed constitutions. Were there a medical supervision and control of the selection of trade by individuals, persons of a scrofulous diathesis, with a tuberculous family history, would not be permitted to embrace indoor, inactive, sedentary occupations, and

certainly not any in which large quantities of dust must be inhaled; nor would nervous, delicate, choleric persons be allowed to enter industries which subject the workmen to great nervous strain, mental worry, and responsibility, nor those in which they may be exposed to toxic agents which act specifically on the nervous system. Perhaps the proper medical supervision of the selection of a trade is as yet a dream of hygienists, but it is bound to be realized.

Already there are legislative enactments in all civilized countries restricting, limiting, and partly prohibiting *child labor*, and the highest aim of hygiene is that no child under eighteen should be allowed, under any circumstances, to engage in any occupation except that of developing its physical and mental faculties.

Female labor is also largely restricted, and even prohibited in some trades; and in many States legal provision is made to limit the industrial activity of women during pregnancy, after childbirth, and in specially dangerous trades.

The *personal cleanliness* of the workers is an important condition in the general prophylaxis of the effects of occupations. It is a fact that in specially dangerous trades, such as printing houses, lead works, etc., and in all industries where poisonous substances are manufactured and manipulated by the employees, those workers who have the least regard for personal cleanliness, who are careless in washing themselves, and who eat their food with hands and clothing full of the toxic materials, are the readiest victims of industrial poisoning; while the more careful often escape all harm. Workers in dusty and poisonous trades should have their hair on face and head cropped short and they should be compelled to observe rigid rules of personal cleanliness, the compulsion being necessary on account of the ignorance of the workingmen and their contempt for the dangers lurking in their trade,—a contempt bred by familiarity.

The wearing of *proper clothing* is an important prophylactic measure in all trades. It must suit the kind of trade in which the individual is engaged. Those who are exposed to low temperatures should wear woollen sweaters or flannel underwear, while workers in high temperatures should wear light absorbing cloth. All who work in damp, moist, and wet places should have their footwear impermeable to dampness, and their clothing should be made of a material which will absorb moisture without letting it penetrate the undercloth. The wearing of rubber-impregnated cloths is inadvisable as it interferes with evaporation of perspiration; mackintosh capes, protecting from moisture and at the same time allowing evaporation, are recommended by some authorities. Persons working in dusty occupations should wear fabrics with smooth surfaces only, and, whenever possible, without any seams, folds, or pockets where dust may accumulate. But the most important prophylactic measure in this respect is that no clothes worn while at work should be taken out of the workplace, but must be exchanged for other clothes which are to be worn only outside the workshop. In some trades the employers are compelled to furnish the workers with two suits of overalls to be worn while at work. In those trades in which corrosive poisons and gases are likely to burn or injure clothing, the worker should wear leather cloth or other not easily destructible material; and wherever the hands come in contact with the same substances leather gloves should be worn. In dusty trades it is advisable to cover the head with closely fitting caps. There are some industries in which the cloth worn is the result of established custom and is usually consistent with hygienic principles. Thus the chimney-sweep's suit, so often seen on the Continent, is very appropriate to his calling, and protects him from contact with the irritating soot.

Duration of Work should be adjusted to the nature of the work and the standard of health of the operatives. Economists agree that there has been no loss of productive capacity since the work day was reduced from sixteen to eighteen hours to the ten-hour-day standard; and owners who frantically struggled against every attempt to reduce the working day, and prophesied the decadence of industry if it was done, have at last come to see that a shorter workday means actually a greater productive capacity and a better state of health in the workers. No universal workday can be established or is applicable to all trades and persons; the length of work should be carefully adjusted to the age, sex, and health of the worker, to the place of work, to the conditions under which it is carried on, and to the character and nature of the processes of each industry. The more unfavorable the conditions under which the work must be carried on, the shorter should be the workday. This is the rule followed in specially dangerous trades; thus, caisson workers are allowed to work for only from two to four hours at a time; furnace workers, or those who are exposed to fumes and gases in lead and other trades, work, as a rule, only in three- to four-hour shifts. The same rule should be applicable to all other trades.

The number and length of the *work pauses* bear an important relation to the health of the employees in each trade, for every physical or mental activity requires periodical relaxation. It has been proven that more work can be done in two hours at the beginning of the workday than in twice that time at the end of the day. In England forenoon and afternoon pauses are required for child workers, besides the usual midday lunch hour. This rule should be adopted for adults also, especially in the dangerous trades. The length of the midday lunch pause should not be less than one hour in any trade, as a shorter pause leads to carelessness and haste in cleaning up, to high speed of food consumption, and to failure of the worker to go outside of the shop for a short breath of fresh air.

Night work is more unfavorable to health than work during the day, and, whenever this is practicable, such work should be restricted; at any rate, the working hours should be comparatively shorter and the pauses longer and more frequent than in day work, and there should also be periodical changes between the day and night shifts, so that those who for one period are engaged during nights should at other times be working by day.

Overwork leads to ill health and to fatigue neuroses, and should be restricted if not entirely abolished. The prophylaxis of the fatigue neuroses can be accomplished only by due regard to the working capacity of the muscles and organs employed. The burden of work, whenever this can be avoided, should not be put on one group of muscles or on one organ. Thus writers, copyists, clerks, and others who have much handwriting to do should train themselves to employ both hands, and besides they should use them in such easy positions as not to overfatigue the muscles. The same principles may be applied to overstrain of other organs.

The proper *education* of the worker in general hygiene, and especially in the dangers of his specfic trade, is an important factor in the prophylaxis of many of the occupational diseases.

The problem presented by the unhealthy condition of *sweatshop* work is a difficult one for legislators, but very simple to hygienists, who are unanimously of the opinion that all home work should be entirely prohibited; and that there should be a complete separation of the factory from the home. It is therefore merely a question of time when the economic obstacles to the abolition of the sweatshop method will be surmounted.

The *construction* of workshops, factories, mills, etc., cannot be gone into here, but there is one requirement which should not be overlooked in this respect, and that requirement is that industrial establishments should be constructed for the specific processes to be carried on therein, and that the plan of adapting any ramshackle, out-of-date building, unfit for any other purpose, to the uses of factory or workshop, as is frequently the case, must be absolutely prohibited. The size of the workplace should, of course, correspond to the number of employees, and to the needs of each establishment. The minimum of four hundred cubic feet of space for each worker, which is established by legislation in many places, is entirely in-

adequate; there should be at least one thousand cubic feet of space for each individual, as a general rule, and this allowance should be increased in special dusty and otherwise dangerous trades. The walls, ceilings, floors, and all surfaces of each establishment should be constructed with due regard to the process of industry carried on within them. Thus, in all places where dust abounds, the walls, and especially the floors, should be made without any cracks, nooks, etc., where dust may accumulate, and should be constructed of smooth material, glass, tiles, or the like, which may easily be washed and scrubbed. In all workplaces where the humidity is relatively very great, the walls and other surfaces should be made of impervious materials. Whenever practicable, the floor should be made of asphalt, concrete, or cement, so as to be impermeable to moisture; it should also be properly graded and drained so as to be easily washed off. This precaution is especially to be recommended in mercury and lead work establishments where the poisonous substances are likely to collect on floor surfaces. Of the cleanliness of industrial establishments it is sufficient to say that it is an indispensable condition of the healthy workshop.

Lighting.—On the proper lighting of workshops depends not only the condition of the eyesight but also the general good health of the workers. The ideal of workshop lighting is the avoidance of anything but daylight as a source of light during work; and, if artificial illumination is absolutely required, the use of electricity only, whenever possible, as other illuminants produce many impurities and unduly raise the temperature of the workshop.

Bussing [14] gives the following requirements for the artificial lighting of factories: (1) The quantity of light should correspond to the normal requirements of the room space and the occupants; (2) the light should approximate the quality of daylight as much as possible, and be white, and in this respect the hygienic value of different lights stands in the following order: electricity, argand burners, open gas flames, and petroleum oil; (3) stability of flame, all flickering and jumping lights being injurious to the eyes; (4) low proportion of impurities given off; (5) low heating capacity. To these requisites may also be added proper distance from the persons at work, proper location of lights, uniform distribution, and shading of eyes when light is too glaring.

Ventilation is the corner-stone of industrial hygiene; for the greatest part of the dangers which threaten the workers are due to the impurities in the air of the places of work, impurities which can be done away with only by efficient methods of ventilation. The impurities in industrial establishments are the following:

I. Impurities caused by the workers: (*a*) decrease in oxygen; (*b*) increase in carbonic acid; (*c*) increase in amount of aqueous vapor; (*d*) increase in temperature; (*e*) increase in amount of organic matter.

II. Impurities due to the place of work: (*a*) detritus from walls, ceilings, floors, and other surfaces; (*b*) increased humidity, due to dampness absorbed and retained in the walls and materials of building; (*c*) moulds, fungi, and other low organisms.

III. Impurities due to artificial lighting and heating: (*a*) increase in amount of carbonic acid and other gases; and (*b*) increased temperature.

IV. Impurities due to presence of machinery, etc.: (*a*) increase in temperature from motion and friction of machinery, etc.; and (*b*) detritus and waste from tools, etc.

V. Impurities due to industrial processes: (*a*) waste and detritus from crude materials being crushed, torn, milled, ground, polished, etc.; (*b*) dust from organic and inorganic substances of manufacture; (*c*) poisons, gases, and fumes; (*d*) infective agents and bacteria. Without going into the detailed study of each of these impurities we shall only consider here how they are to be removed by ventilation. Ventilation is either natural or artificial, according to the natural or mechanical means employed to further it. The natural modes of ventilation are the following:

1. The porosity of the walls and other parts of the building.
2. The various openings made in rooms, such as windows, transoms, doors.
3. Special openings made in windows, walls, ceilings, etc.
4. Chimney flues and other ducts connecting rooms with external air.
5. Cowls and warming devices, made in chimney flues and other ducts.

The last three methods are regarded by some writers as belonging to artificial ventilation, although it is best to limit the meaning of this term to modes of ventilation which are accomplished by mechanical means only. The methods of artificial ventilation are two: extraction and propulsion. By "extraction" methods we mean the ventilation by which: (1) impure air of a room is extracted by means of exhaustors, fans, etc., without special means being provided for the substitution of fresh air; and (2) the extraction of the impure air by the same methods and the provision, at the same time, of special openings or ducts and inlets for the ingress of pure air from the outside. The propulsion method of ventilation consists in: (1) blowing in, propelling, and forcing in air from the outside into the room to be ventilated without making any other provision for the escape of the impure air from the room; and (2) the same methods, plus the addition of special means of escape for the impure air. A combination of the two methods is the best. The motor power for the ventilating devices may be compressed air, water, steam, or electricity. In the propulsion method of ventilation special means may be also provided: (*a*) for filtering the incoming air from its impurities; (*b*) for warming it to a desired temperature; and (*c*) for regulating its relative humidity. In the extraction method of ventilation provision may be made for: (*a*) collecting the impurities of the extracted air in proper receptacles; (*b*) cleaning it by precipitation, filtration, compression; and (*c*) for absorption of gases, etc., by chemical means.

For further details see special books on ventilation, also the works referred to at the conclusion of this article.

Provision should be made in all industrial establishments for artificial ventilation, for by natural ventilation alone it is hardly possible to remove all the impurities to be found in them. In small workshops, with a limited number of employees, with a minimum of waste matter and dust, with no machinery in use, no gases or fumes liberated, natural ventilation may be adequate. But in all other places, especially in large factories, mills, mines, and tunnels, no reliance whatever can be placed on natural methods of ventilation, mechanical means being absolutely indispensable. There is hardly an industry in which some of the above-mentioned motor powers are not used, and wherever there is motive power artificial ventilation need not cost more than the initial expense of the installation of the ventilating apparatus, and should be insisted upon and properly supervised by competent authorities.

In mines the air is full of impurities, and contains various deleterious gases, known as "black damp," "white damp," "fire damp," and "after damp,"—gases which are dangerous on account of either their toxic or their explosive nature. Here artificial ventilation must be provided for on a large scale, though even then much of the danger is difficult to avoid.

Special Prophylaxis. *Dust.*—The following are the prophylactic measures to be observed in those occupations which are characterized by the production of large quantities of dust.

1. Separation, from all other processes, of those in which dust abounds.
2. Substitution of machinery for handwork, whenever this is possible.
3. Substitution of wet for dry processes of production.
4. Instant and continuous removal of formed dust by special ventilators.
5. Isolation of the worker from the dusty process.
6. Frequent change of air and frequent pauses.

7. Special devices for preventing dust from entering the respiratory organs.

1. The processes in which dust is largely formed should be confined to special rooms, which should be kept isolated as much as possible from the other rooms of the establishment.

2. The production of dust may largely be avoided by substituting for hand work carefully enclosed machines. Machine production requires comparatively few operatives, thus lessening the number of persons exposed to dust inhalation. Industries in which the dust has an economic value have already partly accomplished this. In flour and cement mills, and in sawmills provision is made for the collection of the valuable dust and its further utilization. Flour milling was once considered an unhealthy trade; but since the introduction of self-regulating machinery, enclosed in chambers, the formation of dust, from the crushing of the coarse grain to the packing of the finest flour, has been reduced to a minimum. What has been accomplished in a few industries may be repeated in others.

3. Dust is produced only when the industrial processes are performed by dry methods. Wherever possible, wet processes should be substituted by either wetting the material, or the implements, or the place of work, the wetting materially reducing the dust. Wools are sometimes oiled for this purpose. The wet methods are especially imperative in work with poisonous substances, and in the metal grinding industries. Needle, cutlery, stone, and other grinding and polishing can very well be done by wet methods, thus preventing dust formation.

4. The instant and continuous removal of dust can be done only by artificial ventilation and specially constructed devices for each trade. Dust is removed by precipitation, filtration, and absorption. Precipitation of dust is accomplished by the action of the specific gravity of the dust, by the action of water, a stream or shower of which is allowed to fall on the dust thus precipitating it, and also by centrifugal action. Filtration is accomplished by letting the dust filter through cotton, wool, or other material which may be kept dry or wet. The proper ventilating devices for removal of dust consist of the following several parts: (*a*) An expansion or hood, properly fitting or enclosing the tool, machine, or stand of each dust-producing process and worker. This hood must be so adjusted as to cover all surfaces or projections where dust is formed. (*b*) The tubes or ducts with which hoods or expansions are connected; the dust is drawn into the hoods, and conducted from these into the tubes. These latter must be tight, and should be provided with cleaning caps to facilitate periodical cleaning in case of obstruction, etc. (*c*) The *wetting* appliances are in the form of jets, rosettes, streams, showers of water which are applied to the dust in the hood, tubes, or receptacles. (*d*) The *fans*, exhaustors, and other means for aspirating the dust from the hoods and tubes by the creation of a vacuum within the same. The aspirating force must be nicely adjusted to the needs of each trade and process, otherwise the draughts may be too strong. (*e*) *Receptacles* which are connected with the tubes, etc., and in which the dust collects and settles by its specific gravity, by the action of water, or by centrifugal motion.

5. In those industries in which the dust, for one or another reason, cannot be removed, and in which there is great danger that it will impinge upon the face and get into the eyes of the operatives, special appliances have been devised for isolating the worker from his work by an intercepting window, put between him and the dust; or he is separated from it by a complete glass partition, in which openings are made for his arms to go through for the necessary manipulations; or, finally, the work may be done by means of long poles and other tools, manipulated by the workers from the outside of the closed chambers.

6. Wherever dust is produced in large quantities the workers should be given frequent opportunities for inspiring pure outside air, by making the pauses as frequent as possible, and by compelling the operatives to go outside of the shop during these pauses.

7. Workers in dusty trades very often stuff their nostrils and their mouths with flannel or cloth to keep out the dust. The appliances called "respirators" are an extension of the same principle. They consist of a framework made of vulcanite, wire, or metal, which is so constructed as closely to fit the lower part of the face, covering the mouth alone, or the mouth and nose together. Within this framework some filtering material is placed for intercepting and collecting the incoming dust, thus preventing its inhalation. There are a great number of more or less ingenious respirators on the market. One of these, devised by B. W. Richardson [15] consists of a mask in which a breathing tube is fitted, on the inside, with rolled feathers which are so arranged that during inspiration they will rise up and filter, while in expiration they will lie down, like a valve, against the wall of the tube. This is an example of the ingenuity spent on the construction of respirators. The respirators have, however, never been popular with workers; indeed, they are seldom, if ever, worn, unless by compulsion. The objections made by operatives against the wearing of respirators while at work are the following: they are clumsy, uncomfortable, and unsightly; they interfere with respiration; if the filtering material is thick and closely woven, respiration is very difficult—if not, the dust gets through; they interfere with talking, spitting, chewing, and smoking; they get wet by the moisture of the breath, and in general they are a great inconvenience to the wearers, who would rather inhale the dust than wear one of them. In trades where the worker is exposed to violent poisons or specially irritating gases, special masks, entirely air-tight, are provided, and are fitted with tubes to bring in air from the outside, and with complicated valves, etc., to let out the expired air. The objections against respirators already alluded to apply in greater force to those instruments which are used only in very exceptional cases.

The *prophylaxis* in industries where *poisons, gases, and fumes* are evolved and liberated does not differ in its essential features from the prophylactic principles laid down for dusty occupations, except that they must be more strictly and carefully enforced if they are to be effective in protecting the health of the workers. In specially dangerous trades the periodical medical examination of the employees goes very far toward remedying the evils of the trade. Wet methods of production should be insisted upon wherever toxic substances may produce dust. Certain poisons should be entirely prohibited from being used and for them should be substituted other materials less poisonous. Thus the use of any but red phosphorus should be prohibited in the match industry; no arsenic should be used in textile fabrics, on wall papers, etc.; the manufacture of lead toys and utensils should be prohibited, and so also should the employment of lead in pottery glaze and other manufactures. Mirrors may be backed by silver instead of by mercury; and in the place of the latter poison glycerin may be substituted in the manufacture of air pumps. The ideal will be reached when all toxic substances are replaced by non-toxic, and with time and vigorous agitation this ideal may be realized.

Wherever gases and fumes are in such abundance that toxic effects are feared, the wearing of proper protective clothing, respirators, and masks should be insisted upon in spite of the objections of the workers.

Other prophylactic measures, applicable to each industry, differ according to the nature of the toxic substance in each. No alcoholic beverages or acidulated drinks are allowed to arsenic and lead workers, but may be permitted in moderate doses to mercury workers. Workers in lead manufactories are given from ten to fifteen minutes for washing their hands. Sapolio and ammonium tartrate are recommended for the hands, potassium permanganate for a mouth wash. As food, milk and pork enjoy special favor with lead workers, and are furnished by some employers. A number of so-called "sanitary"

drinks have been proposed for lead as well as other workers. The value of potassium iodide as a prophylactic for plumbism, though high in the estimation of some, is doubted by Blum,[16] who made a special study of plumbism.

Chromium workers should have their faces and noses protected with masks to prevent ulceration.

Those who work in soda manufactories and come in contact with chlorine gas are advised to drink a two-per-cent. solution of dilute sulphuric acid.

Phosphorus workers are to be examined periodically by dentists for caries of the teeth. Chalk, milk, saponified water are recommended for those who work in or are exposed to sulphur and its compounds.

The use of common salt is interdicted to mercury workers on account of the danger of the formation of sublimate.

Each industry in which special toxic agents are being manufactured should be provided with special rules for the guidance of the employees, and should also be under the constant care and supervision of proper medical authorities.

The *prophylaxis of infection* from crude materials, or from manufactured articles, is important in the hair, wool, hide, and fur trades especially, on account of the danger of anthrax infection, but it is also important in all trades in which goods are imported from Oriental countries, where certain contagious diseases are endemic. The only effective prophylactic measure, under these circumstances, is proper and thorough disinfection of all suspected materials.

The *special prophylactic* measures against *accidents* to the *eyes* have already been spoken of to some extent in the section relating to the methods of removing dust and toxic materials. Where the danger from flying particles, dust, etc., is very great, it is recommended to wear protective spectacles. A large number of special spectacles have been manufactured for persons whose eyes are thus exposed, but, as in the case of respirators, they are strongly objected to by the workers. The wearing of spectacles is made obligatory in some trades. Koenigshoefer[17] sums up the objections against spectacles as follows: they limit the field of vision, they may impair vision, they sometimes cause headache and pain in the eyes, they are apt to get dimmed by condensed moisture, the metal frame is apt to get hot, and finally, they are uncomfortable. All of these objections may be removed by a proper construction of the glasses.

Prophylaxis against Accidents by Machinery.—This is a science by itself, the study of which requires special technical training. In most countries laws are enacted to safeguard machinery and prevent accidents. Motor engines, fly wheels, etc., must be fenced in and provided with proper guards and rails. Wheels, shafts, drums, belts, and all gearing must be provided with special protective appliances. Circular saws, planes, power looms, and other machinery and tools are all to be properly guarded with approved devices. Many machines and parts of them are at present provided with proper safeguards by their makers. Workers should be thoroughly drilled in the art of self-protection and educated to the dangers of machinery as well as to all other dangers of their calling. This remark applies with special force to workers in large electrical establishments, where a man may lose his life, by coming in contact with a wire carrying a powerful current of electricity.

Offensive Trades.

Thus far the effects of occupations have been considered only with reference to the health of those engaged in them—the workers themselves. There are a number of occupations, however, which affect not only their workers, but the community at large, or, at least, that part of it which lives in their immediate vicinity. These occupations have been named "offensive trades," also "public nuisances." Except in trades which allow poisonous substances or noxious gases to escape outside their precincts, and thus directly injure the health of the surrounding neighborhood, the dangers to health of the so-called "offensive trades" are not direct; at least, it is difficult to show the existence of any diseases or pathological lesions which owe their origin to those trades. Most of the harmful effects of these trades are due to the smoke, noise, and smell produced, which may give rise, in those predisposed to such ailments, to certain disorders such as anorexia, nausea, neurasthenia, anæmia, and kindred ills. The number of offensive trades is very large, and a classification of them has been attempted by the French Government, which divided them into three classes, according to the degree of their offensiveness. Tracy,[18] in his article on "Public Nuisances" in Buck's "Hygiene and Public Health," and S. A. Goldsmith in his article in the former edition of this Handbook, gave full lists of those trades, based on the French classification, as well as detailed technical descriptions of the various processes of the offensive businesses. The space here being limited, only the prophylactic part will be noted, and all technical details will be omitted. The following are the annoying factors in most offensive trades: *Noise, Smoke, Dust, Smell,* and *Noxious Gases and Fumes.*

Noise.—The number of businesses which are characterized by excessive noise is quite large, especially in populous towns. Surface and elevated railroads, driving of heavy wagons over rough pavements, machine shops, forge rooms, blacksmith shops, saw and planing mills, street venders, street music, etc., are a few of them. Excessive noises affect especially nervous, neurasthenic, and sick persons, causing irritability, sleeplessness, anorexia, and general disturbances. A New York physician gave to these symptoms the name of "Newyorkitis," but the malady, if there is such, could better be termed "urbantis," as it is characteristic of all large cities. The prevention of excessive noise is possible in a large degree by municipal action. Thus in New York it is not allowed to create unnecessary noises, especially at night, and near residential streets; street-band music is prohibited in the boroughs of Manhattan and the Bronx, railroad companies are compelled to remove "flat-wheel cars," street peddling is not allowed at night, etc.; with a wider introduction of asphalt pavement a fruitful cause of noises will also be largely abolished.

Smoke.—Among the many nuisances incident to city life is the black smoke belched forth from the chimneys of manufacturing establishments. The composition of the smoke as it leaves the chimney depends on the character of fuel burned, as well as on the methods of combustion and the care with which it is carried on. Black smoke consists of carbon mechanically suspended, and also of other gases, such as carbonic acid, carbonic oxide, and hydrogen sulphide. Wood and bituminous coal give off very abundant and black smoke, while hard coal gives off very little on account of its cohesiveness and complete combustion. When furnaces are of adequate capacity, with grates having a large area, with the coal spread in a thin continuous sheet, and with the requisite amount of air, the production of smoke is greatly diminished.[19] The other remedies, outside of using anthracite coal, are the providing of tall chimneys, so that the smoke shall be emitted above the windows of living houses; and the voluntary or compulsory introduction of smoke-consuming devices. There are a very large number of patented smoke consumers, most of them based on the principle of making a more thorough and complete combustion of all particles of carbon in the fuel.

Dust.—There are only a few businesses in which large quantities of dust may escape outside of the establishments and become a public nuisance. These are carpet-cleaning and beating works, sandblasting of glass, and street sweeping. Carpet-cleaning is now done in large establishments without producing dust. Proper methods have been devised for collecting the dust and preventing its coming outside. Sandblasting of glass is to be relegated outside of residential streets, the dust usually not falling farther than about three hundred feet from the establishments. Street sweeping may be done with comparatively little dust if the streets are previously well sprinkled with water and the cleaners are careful.

Smell.—The trades and businesses which are or may become offensive on account of their smells are very numerous indeed. They include the greatest bulk of generally offensive trades, as they are composed of all the numerous industries in which animal or vegetable matter is manufactured or stored, and which may at certain periods of the procedure give rise to offensive odors. We shall here allude only to the following: (1) The keeping of live animals and of animal matter. (2) Killing of animals. (3) Manufacture and utilization of animal substances. (4) Manufacture of vegetable substances, etc.

Keeping of Live Animals.—As in all offensive trades, the keeping of live animals becomes a nuisance only in populous towns. The nuisance created by the keeping of live animals, such as horses, cows, calves, swine, sheep, goats, birds, poultry, and rare and wild animals consists in: (1) the specific odors peculiar to each kind of animal; (2) the smell from the urine, excreta, and other organic matter from the animals; (3) the noises which are made by them and which disturb the rest of the neighborhood; (4) the flies and parasites which they attract to themselves; and (5) possible infective materials and germs likely to be transmitted to men.

Most municipalities have laws which are intended to abate the nuisances created by the keeping of animals. The remedies for the nuisance are the following: (1) total prohibition of the keeping of certain animals within the city limits, or at least in overcrowded neighborhoods; (2) restricting the building of new places for animals; (3) proper veterinary supervision and disinfection, to prevent disease of animals and infection; (4) proper construction and maintenance of the places where they are kept; (5) removal of all animal matter likely to give offensive odors, or to become putrefied. The rules and regulations of municipalities embrace all of the above-enumerated prophylactic measures. Thus in New York no cows, horses, calves, swine, sheep, or goats are allowed to be kept in tenement houses; no stables are allowed on the same lot with a tenement house; and the keeping of all kinds of animals, even pigeons and chickens, requires a permit from the Health Department. In Boston[19] stables are prohibited within two hundred feet of a church; in Chicago, in order to build a stable, it is necessary to get the permission of the owners living within six hundred feet of the proposed stable.

Most of the offence given by the keeping of live animals is given by horse stables, as comparatively few other animals are kept in cities. Stables should be specially constructed for the purpose. They should contain at least twelve hundred cubic feet of space and one hundred and twenty cubic feet of floor space for each horse; stalls should be at least six feet wide and nine feet long, and the stable should be well ventilated. The floors of stables should be of some impervious material, such as concrete, cement, bricks set in cement; no woodwork that cannot be easily taken off should be laid on flooring. There should be provision for an unlimited supply of water, and the floor should be properly graded and drained, and the stalls provided with longitudinal "valley drains," provided with adjustable covers easily taken up, and the drains should all be tightly connected with the sewer by a properly trapped, extra heavy drain.[19] No accumulations of manure are to be allowed; as soon as it is collected, it should be put into barrels or pressed into bales and daily removed. The removal of manure should be done within the stable, and the carts should be well covered before they start out from the stable. The removal hour should be at night or early in the morning. Thus in Boston manure can be removed only after 12 (midnight); in Jersey City between 6 P.M. and 7 A.M. The stables should be kept scrupulously clean and frequently disinfected with a solution of one pint of formalin to three gallons of water or a similar solution of carbolic acid; corrosive sublimate solution and creolin can also be used. There is no reason why, with such precautions, the keeping of horses should be attended with offence. The keeping of other animals may be made inoffensive by means of similar methods.

The Keeping of Animal Matter.—The storage or keeping of animal matter, manure, offal, bones, hides, horns, skins, fish, garbage, etc., may be attended with offence, on account of the tendency to speedy putrefaction and decomposition, when the decomposing matters may emit very offensive and sickening odors, unbearable by many, and causing headache, loss of appetite, and nausea in others. The prevention of their becoming nuisances can be summed up in the following measures: Immediate destruction, by burning all needless matter likely to decompose; immediate removal from habitations; scrupulous cleanliness; disinfection; keeping of matter in tightly closed vessels.

The Killing of Animals.—The killing of animals is one of the oldest industries of mankind, and has been always in need of state supervision and control from the time of Moses in ancient Egypt until the present. The nuisance created by slaughtering animals consists mostly in the odors peculiar to the slaughter-houses, although other things, such as the noise created by the animals, the flies and parasites attracted by the animal matter, as also the possibility of infection by animal diseases, all play their part in the creation of this nuisance. The offensive smell is due to the animals themselves, the fresh animal guts, blood and other products, and the decomposing animal matter within the buildings. The remedies for the nuisance are: prohibition of slaughtering in any but specified localities; the construction of special municipal abattoirs; the proper building and maintenance of the slaughter-houses, their supervision and inspection; the immediate removal of all by- and waste products; the refrigeration of meat; the absolutely clean condition of the places; the provision of special means for destroying foul- and ill-smelling matter, and the disinfection of the premises.

Municipal provisions about slaughter-houses were inaugurated in the United States as early as 1692 in Boston,[20] and are now found in nearly every community. In New York City slaughter-houses are located only in specified localities, of which there are only four or five. In Boston the slaughtering of animals is concentrated in the Brighton abattoir; and in New Orleans in the municipal abattoir. Cleanliness in the slaughter-houses is provided for in the various sanitary codes, the following being from a section of the New York law: "All those who are responsible for the places should cause such places and their yards and appurtenances to be thoroughly cleansed and purified, and all offal, blood, fat, garbage, refuse, and unwholesome or offensive matter to be removed, at least once in every twenty-four hours after the use thereof; and they shall also at all times keep all woodwork, save floors and counters, thoroughly painted or whitewashed." An unlimited supply of water is even more needed in abattoirs than in stables. Goldsmith quotes Tardieu as saying that in Paris (where the buildings are of iron and glass) ninety thousand litres are used daily in each of the five abattoirs, and adds that in New York a slaughter-house in Forty-fifth Street uses nearly five million gallons a day.[21] The slaughtering of poultry and smaller animals should also be controlled by the municipalities, and most of the prophylactic measures used in slaughter-houses of larger animals are applicable to them also.

Utilization and Manufacture of Animal Substances.—Modern industry does not allow anything to go to waste, and in animal trades there is hardly a substance which is not utilized in some way. Among the many branches of these utilization industries to be discussed here are the following: The rendering of fat and lard; bone and blood-boiling; gut-cleaning; manufacture of glycerin, soap, and glue, and the preparing and tanning of skins and hides.

Fat Rendering, Lard Refining.—Most of the rendering of fat is done by the action of heat, although there are several chemical methods in vogue. Since the trade be-

came concentrated in large establishments, the old method of rendering fat in open kettles has become happily obsolete. The chief nuisance of fat-rendering consists in the odors "which are all caused, partly by the storage of decomposing fat on the premises, but mainly by the distillation of portions of the fat; which produces certain ill-smelling substances, such as acrolein and allylic alcohol, with sometimes capric, caprylic, and caproic acids."[18]

The prevention of fat-rendering from becoming a nuisance is accomplished by the following measures: (1) The use of undecomposed animal matter; (2) the employment of a low temperature in rendering; (3) the boiling of fat in tightly closed vessels; (4) the use of condensers for the removal and destruction of the gases and odors. The New York Sanitary Code has the following section: "That no fat, tallow, or lard shall be melted or rendered except when fresh from the slaughtered animal; and taken directly from the place of slaughter, and in a condition free from sourness and taint, and all other causes of offence at the time of rendering; and that all melting and rendering are to be in steam-tight vessels; the gases and odors therefrom to be destroyed by combustion or other means equally effective." Himes[21] says: "The great secret in preventing nuisance is the avoidance of burning the materials, or even raising them to high temperature. The lower the temperature at which the work can be successfully carried on, the less is the risk of producing offensive smells. The temperature need not exceed 120° F." When steam methods of rendering are used, the need of condensers is imperative. "Condensers may be of several styles and shapes. The water may be introduced at the top, and broken by means of a plate, a short distance below, the shower may also be made by means of a rosette. The condenser itself may be made of iron, copper, or even wood. It should be made as high as possible, in proportion to the diameter. The gases should be introduced at the bottom, and passing up through the water shower, connect with the furnace fires by a pipe near the top." (Goldsmith.[22]) Of the chemical methods of fat-rendering D'Arcet's method is by separation of the fat from its membranes by the action of sulphuric acid. Lard refining differs little from the general rendering of other fats, and, being done mostly by the low-temperature method, it is not offensive.

Bone and Blood Boiling.—In the processes of boiling these animal substances odors may arise which may be quite offensive. The following preventive measures are recommended by the Philadelphia Board of Health:[20] "The floors of all bone-boiling establishments and depositories of dead animals shall be paved with asphalt, or with brick or stone, well laid in cement, and shall be well drained. The boiling of bones, etc., shall be conducted in steam-tight kettles, boilers, or cauldrons, from which the foul vapors shall first be conducted through scrubbers or condensers, and then into the back part of the ashpit of the furnace fire, to be consumed. When bones are being dried after boiling, they shall be placed in closed chambers, through which shall be passed, by means of pipes, large volumes of fresh air, the outlet pipe terminating in the fire-pit."

Gut-Cleaning.—The utilization of the small intestines of animals for sausage skins and the manufacture of catgut is necessarily accompanied by a great deal of stench from the foul-smelling contents of the guts and the decomposition of animal matter. "The processes should be carried on away from habitations; the guts, etc., should not be allowed to come in a foul state, but must be utilized immediately, and proper precautions taken to let no foul matter cling to the floor or surfaces of the establishment. This may be accomplished by the use of plenty of water. The water in the tank where the intestines are macerated may be disinfected by a weak solution of chloralum or chlorinated soda."[18] Parent-Duchatelet (Tardieu) denies that gut-cleaning is harmful to health.

The Manufacture of Soap.—Soap is manufactured from fat and alkalies. It may become a nuisance: (1) On account of the large quantity of fat, tallow, and fat animal residue, which are collected from all animal waste matter, and which are, by the time they reach the soap factory, in a decomposing state. (2) By the processes inherent in fat rendering. (3) By the odors arising from the huge vats and tanks where the fat is being boiled with the alkaline lye. The prevention of the first nuisance is accomplished by insisting that only fat in a fresh state shall be allowed in the soap factories. The means of preventing fat-melting and rendering from becoming a nuisance have already been described. The nuisances caused by the odors arising from the boiling tanks can be prevented by fitting these with covers, and conducting the vapors either outside through a tall chimney, or, as in fat-rendering, through proper condensers.

Glycerin.—When the fatty acids of the fats in soap manufacture combine with the alkalies, the base left is a residue in the form of glycerin, which, before being fitted for the market, must be refined several times. During this process sweetish unpleasant odors are given off, which can be prevented by the same means as those which are used in treating odors from fat rendering.

Glue-Making.—All kinds of animal waste matter, hoofs, horns, skin scraps, leather scraps, etc., are used for the extraction of glue. As in the other processes employed for the utilization of all animal waste matter, the nuisance comes from the decomposing material, from the odors given out during boiling, etc., and from the offensive residue or "scrutch." The remedies are the same as in other kindred processes.

Treating and Tanning of Skins and Hides.—Animal skins, before they are converted into lasting leather, must go through a number of complicated processes. In the scraping, salting, hairing, brining, liming, puering, tanning, curing, and other processes very offensive and disgusting odors often arise; and in liming some sulphureted hydrogen may also be evolved. The process named "puering" consists in soaking the hides in a liquid composed of dog's dung. Tanning establishments should not be allowed in residential localities. The various manipulations may be done with little offence if the places are properly constructed and well kept.

Manufacture of Other Substances.—Among the other substances, the manufacture of which may become offensive, are the following: Illuminating gas, petroleum refining, distilling, brewing, vinegar-making, sugar-refining, boiling of oil, manufacture of varnish, cooking, etc.

Illuminating Gas.—The nuisance caused by the presence of gas works in populous localities is due to various gases and odors given off, during the many stages required, in the process of distilling gas from bituminous coal. The process especially objectionable is the "liming," or passing the gas through a closed chamber filled with quicklime, which is afterward deoxidized and gives off ammonium sulphide and sulphureted hydrogen. Oxide of iron has been substituted for quicklime, with a material lessening of offensiveness. Notwithstanding all the care employed and despite the modern inventions of condensers, scrubbers, and other means for destroying and absorbing offensive gases during the manufacture of illuminating gas, this business is still quite a nuisance to a neighborhood, and the best remedy is to remove it as far as possible from habitations.

In the processes of refining petroleum, offensive odors are given off. These are due to the escape of fumes during its distillation, as well as during the agitation of the refuse or "sludge" acid with alkaline solutions. Goldsmith recommends that the wash water from the agitators should be passed through a series of troughs furnished with cross slots, to retain all oily or tarry matter; and the treatment of the sludge should be carried on at a distance from crowded neighborhoods.

The nuisances caused in the processes of brewing, distilling, sugar refining, and other industries mentioned, consist in the odors given off at certain stages of manufacture and may be prevented by the same methods as those described in the section on Fat Rendering.

Tracy lays down the principles of controlling the nuisance caused by the odors and vapors which are given off during the manufacture of various substances as follows: (1) Conveying and storing in tight vessels. (2) Substitution of less offensive processes for the more offensive. (3) Proper construction of the places where nuisances arise. (4) The use of plenty of water, proper cleanliness, and drainage. (5) The destruction of all offensive odors by passing them through condensers, etc., and from there into the fire pits where they will be consumed.

Gases and Vapors.—The number of the trades which may become a nuisance to the community on account of the vapors, acid fumes, and gases which are evolved in their processes, and are allowed to escape into the surrounding air, is very large. Among the more important of these are all the chemical trades; the manufacture of alkalies, ammonia, bleaching powder, soda, and glass; assaying, smelting, and the manufacture of jewelry, lead paint, certain drugs, etc.

The nuisance created by all of these trades can be summed up in the following: (1) Odors offensive to the neighborhood. (2) Deleterious gases. (3) Destruction of vegetation in the neighborhood.

The remedies advised for the prevention, or at least mitigation, of the nuisances are: (1) Removal, whenever possible, from crowded localities. (2) Dilution of the gases and vapors by air. (3) Condensation of gases by cooling them with water, by passing them once, or several times, either through condensers filled with water or through scrubbers filled with wet coke. (4) Absorption through discharging all gases into fire-pits, where they are destroyed by the action of fire, or by passing them through neutralizing substances, which are of course different for each of the different gases.

George M. Price.

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OCCUPATION DISEASES. See *Caisson Disease; Hands and Fingers, etc.; Lead Poisoning; Lungs, Diseases of: Pneumonokoniosis; Siderosis; etc.*

OCEAN SPRINGS.—Jackson County, Mississippi. POST-OFFICE.—Ocean Springs. Hotels.

This is a station on the railroad between New Orleans and Mobile, eighty-three miles east of the former, and fifty-seven miles west of the latter. It may also be reached by coast steamers from either city. The name of the springs is derived from their proximity to the gulf, the beach being but half a mile distant. According to Walton the springs are most resorted to by citizens of New Orleans and Mobile. The following analysis was made by Prof. J. Lawrence Smith:

ONE UNITED STATES GALLON CONTAINS:

Solids.	Grains.
Sodium chloride	47.77
Potassium chloride	Trace.
Calcium chloride	3.88
Magnesium chloride	4.97
Ferrous oxide	4.71
Organic matter	Trace.
Ammonia	Trace.
Iodine	Trace.
Total	61.33

Gases.	Cu. in.
Sulphureted hydrogen	1.28
Carbonic acid	9.79

The water is a potent chalybeate, the iron being no doubt held in solution in the form of a carbonate. The unusual combination of carbonate of iron, chloride of sodium, and sulphureted hydrogen especially adapts this water to the treatment of diseases of the skin in persons of a scrofulous diathesis. *James K. Crook.*

OCHEE SPRINGS.—Providence County, Rhode Island. POST-OFFICE.—Johnston.

The Ochee Springs are not properly a health resort, although there are many visitors in pleasant weather. There are a number of springs in the neighborhood, but only one is improved at the present time. The following analysis was made by Prof. John H. Appleton, of Brown University:

ONE UNITED STATES GALLON CONTAINS:

Solids.	Grains.
Magnesium carbonate	1.13
Calcium carbonate	3.20
Calcium sulphate	.44
Potassium sulphate	.88
Sodium sulphate	.41
Sodium chloride	.57
Iron oxide and alumina	.75
Insoluble mineral matter	.58
Organic and volatile matter	.87
Undetermined	.15
Total	8.98

This water is pure and wholesome, and is said to act as a mild cathartic and diuretic when used continuously. It has been accorded a considerable reputation as an auxiliary in the treatment of kidney, liver, and stomach troubles. The water is used commercially. *James K. Crook.*

OCHRONOSIS. See *Pigment, etc.*

OCONEE CHALYBEATE SPRING.—Putnam County, Georgia. POST-OFFICE.—Eatonton.

Lake Eaton branch of Central Railroad to Eatonton, and from thence by private conveyance to spring. This spring has had considerable local reputation for a number of years. The waters contain the following ingredients:

Iron carbonate.	Calcium sulphate.
Calcium carbonate.	Sodium chloride.
Potassium sulphate.	Silica.

The iron is insufficient in quantity to warrant us in placing the water in the chalybeate class. The flow is small but constant, the water issuing from a fissure in a granite rock. *James K. Crook.*

OCONEE WHITE SULPHUR SPRINGS.—Hall County, Georgia. POST-OFFICE.—Bowdre. Hotel and cottages.

Location, six miles from Gainesville and two miles from Sulphur Springs Station, on the Southern (Richmond and Danville) Railroad. Hacks meet all trains.

This is one of the most attractive watering-places of the South. Long before the war Southerners of wealth and fashion gathered there annually. A few years ago the property was purchased by Mr. Ferdinand Phinizy, of Athens, and many improvements were made. The old buildings were torn down and a large, well-appointed hotel and handsome cottages were erected. The excellent and liberal management has kept the place popular, and